73rd Annual Fair

Connecticut Science & Engineering Fair

March 8 - 20, 2021

Student Abstracts

High School Life Sciences

Fair Categories

	Life Sciences	Physical Sciences
7th & 8th Grade Team	LT (1001 – 1999)	PT (4001 – 4999)
7th Grade	L7 (2001 – 2499)	P7 (5001 – 5499)
8th Grade	L8 (2501 – 2999)	P8 (5501 – 5999)
High School	LS (3001 – 3499)	PS (6001 – 6499)
High School Team	LST (3501 – 3999)	PST (6501 – 6999)

Special Categories

AT = Applied Technology	EE = Engineering: Electrical & Mechanical
AS = Animal Science	ET = Energy & Transportation
BE = Behavioral & Social Sciences	EV = Environmental Analysis
BI = Biochemistry	EM = Environmental Management
CB = Cellular & Molecular Biology	MA = Mathematical Sciences
CH = Chemistry	ME = Medicine & Health Sciences
CS = Computer Science	MI = Microbiology
EA = Earth Science	PH = Physics & Astronomy
EN = Engineering: Materials & Bioengineering	PS = Plant Science

Special Category Composites

Biotechnology	AS, BI, CB, EN, ME, MI, PS
Environmental	EV, EM
Engineering	EN, EE
Sustainability	EA, EN, EE, ET, EV, EM

CSEF Official Abstract and Certification

Word Count

227

Fair Category

LS

Project Number

3001

Title: Cyanobacteria and its Effect on Elephant Population

Student Name(s): M. Doyle

Abstract:

In late May of 2020, the death of hundreds of elephants in Botswana, Africa, a home for a large number of elephants, caught the world's attention. After additional deaths occurred, scientists were able to identify a possible cause: the presence of cyanobacteria. If there is a greater level of cyanobacteria in the water, then the amount of elephant deaths will increase, because they are extremely vulnerable to the higher levels. This was the focus of the experiment. Cyanobacteria was identified in the Okavango Delta, which is where a large majority of elephant deaths occurred. Using Google Earth Pro's Historical Imagery feature, views of the delta were observed for bacterial growth. Screenshots of theses satellite images were analyzed for any signs of cyanobacteria, identified through bright green coloring. The larger amounts of bright green coloring indicated higher amounts of cyanobacteria in the water of the delta. May, September, and December were observed closely over a period of years. During the period, the percent coverage of cyanobacteria was compared to elephant deaths in the same area. Published values for the elephant deaths in the same period were collected and averaged. This data was compared to elephant deaths in years prior to 2020, to determine if cyanobacteria was a factor in the reported deaths. It was found that as more cyanobacteria was identified in the delta, more elephant deaths occurred.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   EV AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

226

CSEF Official Abstract and Certification

Fair Category

LS

Project Number

3003

Title: Comparing and Exploring Pandemics

Student Name(s): M. Sivalenka, . Sivalenka

Abstract:

The pandemic was devastating for everyone around the world, so I wanted to explore what a pandemic is and compare the COVID-19 pandemic to the pandemics we've had in the past. The outbreak of a virus has a certain criteria to be defined as a pandemic because we can mix up scientific terms around, such as epidemic, pandemic, or outbreak. I also hypothesize that past pandemics have been smaller in size and had a lower percentage of people who were affected by it. To prove my hypothesis, I started researching about pandemics and the parameters of one. A pandemic is a disease that spreads around a country or the world, while an epidemic is at a smaller level. Apart from that, I researched past pandemics, including the pandemics relating to the Flu and the H1N1 Pandemic. As I was finding out more about these outbreaks, there were more questions than I asked. I answered my questions through extensive research and started comparing the past pandemics, epidemics, and outbreaks to the COVID-19 pandemic. For example, most of the pandemics in the past didn't control the disease and that led to many deaths. I used the facts I knew to conclude that this pandemic was deadly, similar to the past pandemics, but had a greater impact on people because of the society we live in today.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   ME BI BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents
☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No
4. Is this project a continuation? ☐ Yes   ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☒ Yes   ☐ No

CSEF Official Abstract and Certification

Title: The Use of Pleurotus Ostreatus As Mycoremediation for Poly-Lactic Acid Plastic In Landfills

Student Name(s): A. Ogrinz

Abstract:

The accumulation of Poly-Lactic Acid (PLA) plastic in landfills creates a dangerous environment for wildlife. The slow biodegradation of PLA plastic means that the rate of decomposition is significantly lower than the accumulation of more plastic which leads to greater leakage of toxins present in plastics. Degrading plastic will slowly leak toxic chemicals that can seep into nearby plants and water sources, poisoning both the land and animals. Pleurotus ostreatus, oyster mushrooms, are capable of the mycoremediation of PLA plastic in cultivated conditions. If oyster mushrooms can continue that trend in landfill conditions, pleurotus ostreatus will be introduced into waste landfill material for evaluation as a viable remediation of PLA. Oyster mushroom spores were grown inside glass jars. 3D printed PLA plastic rings were utilized to test for degradation by the oyster mushrooms. Varying ratios of agar to landfill components from 100:0 percent to 0:100 were utilized. Data collected was analyzed to determine the loss of plastic mass and increase in the oyster mushroom mycelium growth. The plastic discs were found to have an average increase in mass of .183g. Mycelium growth was noted on nine of the eleven trials, leading to an overall increase of mass for the trials with a higher percentage of waste. The results suggest that oyster mushrooms do not have the ability to biodegrade PLA plastic, but do possess the capacity to grow in a landfill environment.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☒ Yes ☐ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

216

CSEF Official Abstract and Certification

Fair Category

LS

Project Number

3005

Title: Application of K-Means and Hierarchical Agglomerative Machine Learning Algorithms to Cluster Wolbachia Genomes based on Host Organism's Phylum

Student Name(s): S. Lee

Abstract:

Wolbachia, a species of endosymbiotic intracellular bacteria, is most notable for its role in vector control strategies to reduce the spread of diseases that are transmitted by mosquitoes, such as malaria and dengue fever. Despite this significance in disease prevention and decades of research, the exact mechanism of Wolbachia's parasitism at the genomic level has yet to be fully understood. Searching for patterns in Wolbachia's genome sequence with machine learning algorithms may offer insight into this mechanism. This project utilizes both the k-means and hierarchical agglomerative clustering machine learning algorithms to explore how Wolbachia's genome sequence is influenced by its host organism's phylum. From the NCBI database, Wolbachia genomes from both arthropod and nematode hosts were collected then preprocessed. Cluster analysis was performed on this data and visualized using Voronoi diagrams and dendrograms, which both showed stark clusters of genomes organized by the host organism's phylum with a high accuracy of 88.5%. These findings indicate a strong correlation between Wolbachia genomes and its host, suggesting that Wolbachia species adapt their genetic sequence based on its host organism's phylum. This result is promising in enhancing the understanding of Wolbachia's parasitic mechanism and also offers potential future studies, such as searching for the specific genes that differ for Wolbachia in the various hosts and applying classification algorithms.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) MI CS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count

232

Fair Category

LS

Project Number

3006

Title: Transmission of COVID-19 Through Aerosols Spread by Musical Instruments

Student Name(s): G. Gassira

Abstract:

Many musicians have struggled and have been infected simply from resuming rehearsals during the pandemic. By creating airflow through playing an instrument, aerosol transmission occurs. Recent studies have proven that a significant number of COVID-19 cases are due to the transmission of aerosols. Data obtained from a recent study at the University of Minnesota shows how a variety of instruments generate aerosols. This information will be applied to the school orchestra to determine if current rehearsal protocol if safe. After further research, it has been determined that the aerosol concentration instantly decreases when it travels farther from the source. At four inches away it is about ten percent of what it was at the source, and by one foot away there is very little. To prove how concentration decreases, this information will be applied to the flute players, the most common wind instrument in the school orchestra. This will show that there is no great risk of aerosols generated from one person reaching another, but it is still not impossible. The aerosols do not spread as far as expected. The flow is confined at the source, then the aerosols disperse. However, it is still necessary to take extra precaution. This includes at least six to nine feet between musicians, and masks made specifically for playing. If this were to continue for a long time, maintaining these practices will keep everyone safe.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   EA

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count

246

Fair Category

LS

Project Number

3007

Title: Genes Dysregulated in Obesity Increase the Likelihood of Breast Cancer Development

Student Name(s): J. Boyar

Abstract:

The American Cancer Prevention Study II found that mortality due to all cancers was 52% higher in obese men and 62% higher in obese women, compared to individuals with a normal body-mass index (BMI). Among all cancers, breast cancer is the most commonly diagnosed and affects 12% of women in the United States alone. In this study, we sought to determine if gene dysregulation is a factor that increases the likelihood of breast cancer development in overweight and obese women. To achieve this goal, gene expression data from 300 women were analyzed using RNA-seq. Weighted Gene Correlation Network Analysis (WGCNA) was then used to determine the modules of coregulated genes among the cohorts. These modules were compared to specific variables to determine the relationships between the modules and traits. Finally, the pathways of the most significantly dysregulated modules were analyzed to determine which bodily functions they impacted. The WGCNA analysis resulted in a single module that was highly upregulated with BMI and contained genes associated with various immune, collagen, and extracellular matrix pathways. This module included the gene TGFβ1 - a gene that has been repeatedly linked to cancer development - thus validating the results of our studies. The module of genes upregulated with BMI is likely linked to breast cancer development in obese women. In the future, a method of inhibiting these genes would decrease the likelihood of breast cancer development in not only obese women, but also in others with similar breast cell makeups.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

CS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count

249

Fair Category

LS

Project Number

3008

Title: Potential Use of Marine Microalgae to Absorb Excess Salt Road Runoff

Student Name(s): Z. Succow

Abstract:

Not too long ago, winter headlines were dominated by snowstorms. One of the major concerns with this is our ability to traverse main roads in town. We have long used a variety of salt mixtures to drop the freezing point of the icy conditions, but this has come under ever increasing scrutiny due to the adverse impacts the salt has on automobiles and the danger it poses as a pollutant to the environment. Marine phytoplankton have a well documented ability to absorb lighter ions (salts) for a variety of biochemical reasons (Cole et.al, 1993). This planktonic metabolic process was tested here to evaluate its potential use in absorbing the excess salts applied to the road prior to their arrival in surrounding environments. Replicated trials saw road salts comparable to DOT mixtures applied to grass patches grown in a lab. Although inconsistent, there was some evidence that marine phytoplankton will absorb the salts and further testing will be needed to confirm and evaluate. The results also raised another question for future research. Phytoplankton that absorb salts in the roadside theoretically would degrade, but would the salt then be released back into the surrounding environment or be reconfigured in the biological breakdown of the algae. The temporal aspects of this research question definitely need further study, something beyond the scope of what we could get done, but intriguing nonetheless. The prospect of having a phytoremediative technique to combat the negative impacts of road salts is a huge win for the environment.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   BI EM EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

Word Count

256

CSEF Official Abstract and Certification

Fair Category

LS

Project Number

3009

Title: Exploring Earthworm Ecotype: Carbon Source or Sink?

Student Name(s): L. Kane

Abstract:

Climate change is arguably the most pressing issue currently facing the world. Earthworms contribute to both carbon emissions and sequestration, potentially significantly impacting global carbon stores, although definitive conclusions about long-term effects are not established. In four lightless, air-tight microcosms each containing 2500 grams of soil, 500 grams water and 75 grams leaf litter, I analyzed the effect of earthworm ecotype on CO_2 emissions. The control contained no earthworms, demonstrating microbial sequestration. Five grams of two earthworm ecotypes, epigeic (surface dwellers) and endo-epigeic (upper soil dwellers), were placed in separate containers; a fourth box contained 2.5 grams of each ecotype. I measured CO_2 and O_2 with Vernier gas probes; providing supplemental O_2 as needed. Within 10 days, CO_2 levels decreased in all four boxes. Over a 73 day period, endo-epigeic worms produced the least CO_2 on average while both ecotypes together produced the most, a difference of almost 9000 ppm. Once reaching CO_2 stabilization on day 18, emissions never oscillated more than 3,200 ppm daily. When dried and sieved, large macroaggregates (>2000 μm) constituted 44% of endo-epigeic soil and only 17% of epigeic soil, indicating endo-epigeic worms sequester more carbon. Because endo-epigeic worms produced less CO_2 than the control, this ecotype appears to play an active role in carbon sequestration generating net negative carbon emissions compared with environments lacking earthworms. As we seek to better understand and mitigate anthropogenic climate change, these findings provide important insights into an under-researched part of this problem as well as potential solutions.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   EA EV MI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Spider Silk Amino Acid Composition and Its Impact on Structure Function: A Novel Computational Approach

Student Name(s): H. Servin-DeMarrais

Abstract:

This project analyzed how the functionality of spider silk is impacted by its amino acid composition. All spider silks are composed of the protein family known as spidroins. There are a variety of spidroins that produce each silk type. Silk properties like flexibility and tensile strength are owed to the protein's amino acid composition.

The hypothesis stated that there is a correlation between different silk types with similar capabilities and their most abundant amino acids. Amino acid composition of spidroins greatly impacts the function of silks, meaning that amino acid makeup is a determinant of structure function.

To test this theory, I coded a tool using Python that displays a breakdown of the amino acid composition per sequence. It was determined that the spidroins that possessed similar functions to each other were the Tubuliform and Aciniform spidroins, and the Major and Minor Ampullate spidroins. Tubiliform and Aciniform spidroins are both used for wrapping mechanisms, while the minor and major ampullate spidroins are associated with web building. Analysis of the spidroins using the tool displayed a proportional makeup of amino acids seen in the genome of each pair. The Tubuliform and Aciniform spidroins had the same top five most abundant amino acids. The Major and Minor Ampullate spidroins also shared matching top five amino acids.

It was determined that amino acid abundance impacts the function of the silk it produces. Through this data, spider silk genetics can be better understood and replicated in the future for medical, engineering, and industry purposes.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   CB CS BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Analysis of regenerated mouse digit tips following modulation of Amphiregulin expression

Student Name(s): L. Hisiger

Abstract:

Axolotls, humans, and mice all possess the areg gene. There exists a correlation between increased areg expression and decreased regenerative capabilities in axolotls. Humans and mice do not have the same regenerative capabilities as axolotls. However, mice and human children can both regenerate their digit tips. The purpose of this experiment is to determine the effect of a lack of areg expression on mouse digit tip regeneration.

I used ImageJ software to determine the area of the regular and contralateral regenerated triangular digit tip bones in mice both with and without functional areg genes. The area of the regenerated bone was divided by the area of the control bone. The percent changes were compared between the mice with and without functional areg genes to determine the effect of the gene on bone regeneration.

A functional areg gene and thus a presence of amphiregulin leads to increased resource devotion and efforts to healing rather than regeneration. This means that regenerated digits in mice with a functional areg gene will be more similar in size to the control digit than in mice without functional areg genes.

Regeneration in humans is very similar to mice. Additionally, both species have the areg gene with similar functions. This means that an areg gene knockout in humans may increase regenerative ability when necessary. By enabling humans to regenerate themselves, certain tissue damage conditions may be treated or even completely healed.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   AS ME MI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Relationship between the area of equilateral triangles compared to the sum of the areas that follow

Student Name(s): G. Phillips

Abstract:

In this study the repeatability of the spidron pattern was analyzed. The spidron pattern is a series of isosceles and equilateral triangles that follow the other in an alternating pattern infinitely. Daniel Erdély, the mathematician who discovered the spidron pattern, found that the sum of the area of triangles following an equilateral triangle is equal to the area of that equilateral triangle. To investigate further into Erdély's work, the research question for this study is, does the sum of the areas in the sequence of spidron triangles that follow an equilateral triangle equal the area of the equilateral triangle itself? The results of this study showed that the equilateral triangle in all the groups did not equal the sum of the areas that followed it. This did not fit into the predicted results because the total sum of the areas was either smaller or larger than the area of the equilateral triangle they followed.

The importance of the spidron pattern carries into engineering and the designing process of buildings and different types of toys. The work done in this study can lead to different shock dampeners, crumple zone in cars, as well as solar cells that will follow the sun and different stars.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) EE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- [ ] human subjects
- [ ] vertebrate animals
- [ ] potentially hazardous biological agents
- [ ] controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Combatting Nitrogen Pollution and Eutrophication Using Denitrifying Bioreactors

Student Name(s): J. Wu

Abstract:

Nitrogen fertilizers and other sources of nitrogen runoff are polluting coastal waters with nitrate, causing eutrophication. The excess of nutrients promotes the growth of primary producers which depletes the water of oxygen, resulting in the loss of aquatic animal life. Recent research suggests that denitrifying bioreactors composed of wood chips can act as a carbon food source for naturally occurring microorganisms that convert nitrate into harmless nitrogen gas. The goal of this research is to determine the effectiveness of various substrates — namely wood chips, corn cobs, banana peels, and bamboo leaves — at denitrification when placed in the flow path of contaminated water.

Denitrifying bioreactors were constructed in bottles growing Pisum sativum, and the fertilizer runoff was drained through the bioreactor substrate. The treated water was tested using the Salifert nitrate test kit, forming a solution that changed color based on the nitrate concentration. An iPad-based application was used to determine the RGB hex code, from which a defined lightness value of the solution color could be found. An equation was derived from the color hex codes and the corresponding nitrate concentration in parts per million (ppm) on the given Salifert color chart. Compared to a nitrate concentration of 14.3 ppm for the untreated contaminated water, the denitrifying bioreactors filled with banana peels and corn cobs were the most effective, reducing the nitrate concentration by 10.3% and 16.0%, respectively. This research suggests that cost-effective denitrifying bioreactors made with certain agricultural byproducts are effective at reducing nitrate pollution.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   EV   EA

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Title: Bacterial Decomposition and Consumption of PET Plastics as a Sole Metabolic Energy Source

Student Name(s): A. Hall

Abstract:

The purpose of this experiment is to identify the decomposition of PET (Polyethylene Terephthalate) when exposed to the bacteria Ideonella Sakaiensis. Due to the large issue of plastic waste and plastic pollution throughout the world. The goal of this experiment is to provide a possible new insight into new recycling methods. Throughout the world there are many issues and logistical challenges with recycling. This is especially the case in many underdeveloped nations. Exploring alternative routes of recycling could possibly bring about change. This change could come about in many forms, economic and environmental, would be two front running forms of change. While this analysis may not uncover a breakthrough in recycling methods, it could help address the growing issue of micro-plastics in the marine environment. It is hypothesized that research will display similar rates of degradation.

The objective of this research is to analyze data across multiple sources. (Knott et al.) (Palm et al.) The purpose of analyzing these sources is to find noticeable variations in data across the existing sets of data. After analysis it is expected that there will be variations in I. Sakaiensis strains. In both sets of data it is likely that there is variation within I. Sakaiensis protein structure and protein production. It is also important to note differences in methods and approaches taken by each study. Both studies take different approaches to data collection. One study, (Knott et al.), engineer I. Sakaiensis to implement an additional MHETase mutant (S131G) to modify the bacteria.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) CB EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Chromosomal Instability of RB1 in Osteosarcoma

Student Name(s): P. Vora

Abstract:

Even though the gene RB1 was one of the first tumor suppressor genes ever found, and it has been extensively researched, there are still many questions that remain on how it could promote treatments and therapeutic strategies to treat osteosarcoma. Chromosomal instability is a hallmark of osteosarcoma and the deregulation of this mechanism in tumorigenesis forms the beginning of my work. For my data retrieval, I will use an array of publicly available databases like NCBI GEO, DAVID, STRING, and UCSC genome browser. I will collect candidate genes from NCBI GEO and analyze them in DAVID in order to find novel regulatory connections to osteosarcoma tumor initiation and progression. I will put this information into STRING and UCSC genome browser to find regulatory sites that will be important in understanding regulation. So far in my data analysis, I have found out which genes are up and down regulated, which genes are related to osteosarcoma as well as other cancers. For example, the genes KLHL23, BRI3BP, PHF11, and ATAD3B are all found in either breast, lung, and/or gastric cancer. The goal of this project is to fully understand the relationship between genes that are disrupted during osteosarcoma tumorigenesis. After generating the list of genes, Dr. Hansen's laboratory can use that to screen for personalized medicine actions for treating osteosarcoma. The information that I have found and will be finding is vital to the scientific community because it will allow more pathways to open for potential treatments and therapies for osteosarcoma

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) ME CB

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: An Investigation of the Effects of Spices on Zebrafish Embryonic Development

Student Name(s): B. Akberzai

Abstract:

The intent of this part of the experimentation is to further provide information regarding the conducting of my experiment. In my experiment, I am essentially finding out what effect spices have on the development of aquatic organisms? More specifically I would like to see the effects on Zebrafish embryos because they are unique in the sense that they are transparent so you are able to view them. A research question that I am also discovering is what effect does black pepper, turmeric, and saffron have on the development of zebrafish embryos from days 0 to 6.5 post fertilization? In the medical field, medicines are derived from certain plants and I would like to further use that field of study in medicine which is known as Ethnopharmacology. In finding the answer to my question the idea is to gather hypotheses and observations before conducting my experiment so that I will have the necessary resources in planning my procedure for the experimentation. Although I haven't had the opportunity to test primarily due to not having access to the materials the procedure will be the same. It would be interesting to see the results of this experiment once it is conducted because there aren't many studies or trials on this topic.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

CB ME AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☒ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
269	**LS**	**3018**

Title: Linking Continued Exposure to E-Cigarette Vapor Constituents with Chronic Obstructive Pulmonary Disease

Student Name(s): H. Goldenberg

Abstract:

E-cigarette usage continues to grow in popularity, however the correlation between frequent e-cigarette use and ensuing respiratory disease remains unexplored. To that end, a correlation between exposure to e-cigarette compounds and COPD was sought. Human bronchial epithelial cells (HBEs) were exposed to practical concentrations of e-cigarette liquid, nicotine, diacetyl, ethanol, and phosphate-buffered saline; an LDH cytotoxicity assay measured the toxicity of e-cigarette liquid, nicotine, and diacetyl. Increased LDH indicates tissue/cell damage; specifically, e-cigarette liquid caused a 32% increase in LDH, while diacetyl caused a 26% increase. The mRNA produced by cells was templated to produce cDNA, which was analyzed for augmentation of genes MUC5AC and MUC5B. Increased MUC5AC/MUC5B is indicative of increased mucin production, which is directly linked to COPD. Increased MUC5AC gene expression was found for diacetyl (1.3x), e-cigarette liquid (2.2x) and nicotine (2.3x). Diacetyl caused 1.2x increase in MUC5B gene expression. A Western Immunoblot of proteins within e-cigarette-treated HBEs highlights a 54% increase of MUC5AC protein that codes for the MUC5AC gene, further supporting increased mucin production and increased COPD risk. Collectively, LDH and MUC5AC/MUC5B increases highlight COPD risk for e-cigarette users. Next, genetically-modified D.melanogaster BDSC-52262 were exposed to e-cigarettes and tobacco cigarettes. For each, fruit flies experienced decreased locomotor activity and lifespans, along with disrupted sleep cycles. Likewise, fly triglyceride concentration was similarly lower for both cigarettes. While LDH/MUC5AC/MUC5B results highlight the causation of COPD from e-cigarette use, decrease in locomotor activity and triglycerides for both cigarettes further demonstrates their similarities in disrupting crucial metabolic pathways.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) CB ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects ☒ potentially hazardous biological agents
☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: The Relationship between Anti-Discrimination Legislation and Hate Crimes Based in Sexual Orientation and Gender Identity

Student Name(s): S. Morris

Abstract:

The discrimination of LGBTQ+ students in the United States education system has become a focus of the justice system over the last decade. This study analyzes the relationship between anti-discrimination legislation and hate crimes committed per state with a bias to sexual orientation and gender identity. Evidence was collected from states that passed anti-discrimination legislation from the year before and the year after it was passed, as well as evidence from states that have no anti-discrimination legislation. California, for instance, passed anti-discrimination legislation in both 2010 and 2012, and had a 1% decrease in the hate crime ratio from 2010 to 2011 and neither an increase nor decrease from 2012 to 2013. The study demonstrated that the implementation of anti-discrimination legislation led to either a decrease or lack of change in the ratio of hate crimes with a bias towards sexual orientation and gender identity to overall hate crimes in that state/territory per year per state. The results of this can be used to further an argument in favor of nationwide anti-discrimination legislation for LGBTQ+ students in order to prevent the increase in hate crimes based in sexual orientation and gender identity.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   BE   ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract.   ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution.   ☐ Yes   ☒ No

4. Is this project a continuation?   ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Title: The Cognitive Abilities of Bearded Dragons

Student Name(s): G. Squatrito

Abstract:

The cognition of animals needs to be studied and understood to ensure they are properly cared for in captivity. As the number of animals kept in zoos or as pets continues to increase, it has become clear that caring only for their physical needs is insufficient. In order to truly be healthy, animals need to be enriched, and we cannot properly enrich them if we do not understand their cognition. Despite being one of the most popular reptiles to keep as pets, bearded dragons' cognition has barely been researched. This lack of understanding means owners are uninformed, and often keep these lizards in environments that provide little to no enrichment. This improper management only leads to boredom, the development of poor habits, and stress for the animals. Establishing an understanding of bearded dragons' cognition is critical in being able to properly enrich them. The purpose of my research is to establish an effective method of target training through the use of a coding protocol, which simultaneously proves a bearded dragon's cognitive potential in areas such as learning, and spatial cognition.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☒ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

CSEF Official Abstract and Certification

Fair Category

Project Number

230

LS

3022

Title: Use of Accelerometers to Determine Gait Irregularity

Student Name(s): V. Calmon Coelho

Abstract:

Examining a patient's gait can give more insight into the patient's condition. One method to assess a gait is through accelerometers. Gait assessments can be done with a motion capture camera, but a less invasive approach, such as accelerometers, would allow for broader use. The objective of this study is to differentiate gait irregularity through the use of an accelerometer. It is predicted that variations in time between successive steps will identify gait irregularities. A rectangular area will be set up with accelerometers lined up on one long side of the rectangle. A subject with no conditions will walk around the square simulating five gait irregularities. Another trial will be run with a natural gait as a control. The accelerometers will record ground force data. The ground force data will be analyzed in MATLAB to remove background noise and manipulate the data. The data showed a slight difference between a normal gait's time between successive steps and that of a simulated gait irregularity. This will allow accelerometers to be used in a wider range of situations, such as home use. Home use gives more data, resulting in a better gait assessment. With more knowledge about gaits, medical professionals will be able to give better care, such as a physical therapist giving more specific treatments. Additionally, eventually, accelerometers can be used to create a wearable gait assessor, allowing for widespread use.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   ME CS EE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☐ Yes ☒ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Analyzing the Role of Sonic Hedgehog Signaling in Germinal Center B-Cells by Single Cell RNA-Sequencing

Student Name(s): W. Zhang

Abstract:

The germinal center (GC) is a stem-cell like niche crucial to the creation and proliferation of a type of lymphocyte, GC B-cells, that provide effective humoral immunity to protect against unique and recurring pathogens. While GC B-cells have the potential to differentiate into antibody-secreting plasma B-cells, memory B-cells, or to undergo self-renewal, which each serve unique functions, the factors that regulate GC B-cell differentiation are unclear. This is crucial as B-cells are necessary to the immune response. If the factors that induce B-cells to become memory B-cells are better understood, vaccines can more effectively target viruses, and in the same way, target plasma cells in treatments. In this project, I propose that the Sonic Hedgehog (SHH) signaling pathway, a molecular process that results in a transcriptional change, is necessary to prepare GC B-cells to differentiate. Last year, I used immunofluorescence staining on lymph node tissue samples to note the existence of cells that demonstrated characteristics of both early plasma B-cells (cytosolic Ig+) and self-renewal cells (bc16+). This year, using Single Cell RNA-sequencing data from "Novel specialized cell state and spatial compartments within the germinal center", I clustered B-cell data sets using the Louvain method in R with guidance, producing 8 clusters. Of the clusters that expressed SHH, expression levels did not indicate a clear fate of a plasma, memory B-cell, or self-renewal cell. In both methods, these cell populations, while not previously recognized as a discrete subset within germinal centers, likely represent a crucial transitional stage reliant on SHH signaling.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) CB ME MI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects ☐ potentially hazardous biological agents
☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☒ Yes ☐ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
255

Fair Category
LS

Project Number
3024

Title: Developing an Adhesive Constructed from a Maize-based Matrix Mixed with Chondrus crispus Carrageenan and Determining its Solubility in Saltwater

Student Name(s): M. Duffy

Abstract:

Epoxy and acrylic based bandages present a bio-hazardous, non-biodegradable waste product. With the amount of trash in the ocean accumulating at an alarming rate, the need for plastics requires mitigation. A biodegradable adhesive would eliminate the annual production of tens of millions of pounds of epoxy. The goal of this research project is to develop an adhesive made from organic material to replace the plastic bandage adhesive; the project will test the solubility of the adhesive in seawater. Cornstarch and carrageenan extracted from Chondrus crispus (Irish Moss) were used for the adhesive matrix. The carrageenan was extracted by first heating the seaweed in a 60% calcium hydroxide solution at 60°C for 60 minutes, then boiling the seaweed in a 5% potassium chloride solution for 20 minutes. The carrageenan was then added to a bowl containing cornstarch, water, and corn syrup. The adhesive is placed in 0.5-L of seawater. The average density of the top layer, the bottom, and the middle of the saltwater is recorded for data collection, and biodegradation is analyzed through salt fractionation. Two of the three densities both reached a density of 1.05g/mL, but one density reached 1.07g/mL. One problem raised by this project is the adhesion of the mixture. The epoxy and acrylate bandage adhesive was much more adhesive than the organic adhesive, adhering to artificial skin for about 750 more minutes. The adhesive became moldy after three weeks at room temperature, therefore another preservative is needed in order to increase the practicality of the adhesive.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   EM PS EN

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☒ potentially hazardous biological agents
☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Low-Pressure Application of Metal Nanoparticles to Soybean Seeds to Provide Increased Resistance to Fusarium virguliforme

Student Name(s): U. Pendkar

Abstract:

Fusarium virguliforme is a major pathogenic fungus that affects ~30% of global food crops annually, resulting in plant yellowing, wilting, stunting, and death. While current treatments for crop disease offer varying levels of effectiveness, the most promise lies in pre-treatment methods that would bolster the plant's immune system. Recent research has suggested that metal oxide nanoparticles may provide immune-boosting effects for healthy plants against Fusarium wilt, however methods for their inclusion onto and into the plant remain unclear. In this research, copper nanoparticles (CuNPs, 10-40nm) were introduced to (model) soybean seeds via an innovative 10-minute, reduced pressure (0.1atm) soaking within a 500ppm CuNP solution in deionized water. SEM and EDS analyses confirmed the successful integration of the CuNPs below the seed coat, into the radicle and endosperm. Three-week growth experiments with these CuNP seeds, as well as normal/dry, and low-pressure (in water) seeds, were conducted for healthy and Fusarium-inoculated plants. While all seed types germinated in 10 days, introduction of Fusarium to normal-seed plants caused wilting, with 25.4% and 50% decline in plant growth and biomass, respectively. Conversely, low-pressure-infused CuNP seeded plants produced ~3.5% increase in plant growth relative to normal, healthy plantings, and as much as 39% and 106% increases in growth height and plant biomass respectively, relative to normally-seeded plants suffering from Fusarium wilt. These collective results highlight the efficacy of the newly-developed, low-pressure application of 500ppm CuNPs into seeds to promote increased crop biomass, while acting as a pre-emergent to inhibit the effects of Fusarium virguliforme.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) EM PS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
250

Fair Category
LS

Project Number
3026

Title: Deep venous intervention surgeries for lower extremities in out-patient offices do not create additional complications compared to hospital setting

Student Name(s): N. Kucher

Abstract:

Approximately 30 million of Americans suffer from chronic venous insufficiency. Although many may not realize this due to a variety of the symptoms, this means that the blood that flows to one's extremities is unable to travel efficiently. The symptoms can be as mild as a bit of swelling to as serious as ulcers that can get infected and lead to amputation. Though extreme, there are interventions that can be done to help reverse these effects by restoring proper blood flow. These procedures require a catheter to be inserted into the patient's veins, so that either a balloon can be used to inflate and eliminate the blockage, or so a stent (metal cage) can be used to hold the vein open, allowing the blood to properly flow. Although these are simple procedures, there is persistent fear that it is not safe to have these procedures performed in an outpatient setting and that hospital settings are safer options. However, out of the 539 selected patients, we found that there were no hospitalizations within 6 weeks of the procedure in an outpatient setting, indicating that the procedures are safe to be conducted in the outpatient offices, as well as hospitals. Our study shows that patients should feel comfortable having their procedures done outside of a hospital. With the increased risk of catching a variety of different viruses and infections in hospitals, not only does having a procedure in an outpatient office remove this risk, but the procedures are also safer for patients.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents
☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Investigating the Efficacy of Cannabidiol on the Elongation Time of Coagulation to Mitigate Intravascular Blood Clots

Student Name(s): M. Dos Santos

Abstract:

This project was designed to investigate the efficacy of cannabidiol distillates (CBD) on the elongation time of the coagulation cascade. The coagulation process is extremely important, however, sometimes the hemostasis mechanism fails, which leads to the formation of unnecessary blood clots which remain in the bloodstream. Many medical conditions can arise from these unwanted loose clots, including deep vein thrombosis and pulmonary embolism. Treatments from conditions like this include blood thinners such as warfarin and compression stockings. It is proposed that CBD's wide-ranging therapeutic properties include coagulation mitigation. The cannabidiol distillate used in this project is certified 0% THC content. To evaluate the CBD/coagulation cascade relationship a series of prothrombin time tests (PTT) with CBD ranging from 0.1ml to 0.3 ml to provide a definitive conclusion that CBD can mitigate coagulation cascade destabilization.

The average PTT results acquired in this experiment are as follows: 29.19 seconds, 28.61 seconds, and 21.83 seconds. Compared to the controls ranging from 11.23 to 13.81 seconds, the data proves that cannabidiol distillates does in fact prolong the clotting time by up to 129%, which proves that CBD can be utilized to treat life-treating conditions such as DVT and pulmonary embolism. This research can easily be furthered by exploring effective delivery methods of CBD into the bloodstream. In addition, new experiments can be performed in order to test the effects of different forms of CBD on the clotting system, such as crystalline CBD isolate or cannabis salt.

**Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)** ME BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☒ potentially hazardous biological agents
☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☒ Yes ☐ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Investigating the Efficacy of Cannabidiol on the Elongation Time of the Coagulation Cascade to Mitigate Intravascular Clots.

Student Name(s): M. Dos Santos

Abstract:

This project was designed to investigate the efficacy of cannabidiol on the elongation time of the clotting system. The coagulation process is extremely important, however, sometimes the hemostasis mechanism fails, which leads to the formation of unnecessary blood clots that remains in the bloodstream. Many medical conditions can arise from these unwanted loose clots, including deep vein thrombosis and pulmonary embolism. Treatments from conditions like this include blood thinners such as warfarin and compression stockings. However, since cannabidiol has gained the attention of researchers worldwide due to its wide-ranging therapeutic properties, its effects on coagulation were tested by conducting a series of prothrombin time tests with different concentrations of CBD in order to prove that this substance can dissolve intravascular blood clots.

The cannabidiol oil used in this project was "solely produced from sustainably grown organic hemp that has been registered and approved by the Colorado Department of Agriculture." In addition, all of their products are derived from CDA-licensed hemp and none of it contains THC.

The data collected in this experiment shows that cannabidiol does prolongate the clotting time, which proves that CBD can be utilized to treat life-treating conditions such as DVT and pulmonary embolism. This research can easily be furthered by exploring safe ways to make the CBD enter the bloodstream. In addition, new experiments can be performed in order to test the effects of different forms of CBD on the clotting system, such as crystalline CBD isolate or cannabis salt.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) ME BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

248

Fair Category

LS

Project Number

3028

Title: The Biofilm Promoting Nature of Bacteriophages in In-Vitro Escherichia coli Biofilms

Student Name(s): A. Tischer

Abstract:

Antibiotic-resistant bacteria are a growing threat to many healthcare institutions throughout the world. Escherichia coli (E. coli) is a bacteria that often develops antibiotic-resistance and is a common catheter-associated antibiotic-resistant urinary tract infection (CAUTI) causing bacteria. Due to E. coli's ability to survive antibiotic administration and form biofilms, there has been a renewed interest to develop new treatments. The use of bacteriophages (viruses that only infect bacteria) as a potential treatment for antibiotic-resistant infections, such as E. coli CAUTI, are a promising alternative to conventional antibiotics. This study seeks to determine the efficacy of bacteriophages when breaking down E. coli. biofilms. It is hypothesized that the bacteriophages will be able to break down E. coli biofilms and destroy all or significantly reduce viable cells within the biofilm. The independent variable is the bacteriophage treatment and the dependent variable is the amount of E. coli. lysis. The controls are the E. coli. Biofilms that are not treated with bacteriophages. Each trial will be tested in triplicate and grown in pooled human urine. After a set incubation period, bacteriophages are added to the experimental trials. All trials then go through a MTT assay to enumerate the amount of viable cells within the biofilms. The results are analyzed to determine the cell viability from the MTT assay. Current data trends do not support the hypothesis. The results of this study, if shown to have a high efficacy, will provide a new treatment for E. coli CAUTI.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects ☐ potentially hazardous biological agents

☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☐ Yes ☒ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Comparison of Potential for Coastal Marine Macroalgae to Absorb Excess Nitrate in Runoff

Student Name(s): L. DeCola

Abstract:

There has been a recent resurgence of interest in human impact in coastal ocean waters for a variety of reasons. It has long been known that nitrogen runoff is one of the largest contributors to this impact, but natural sinks and mitigation techniques have been greatly understudied in my opinion. The species of nitrogen entering our waterways and the ability of known nitrogen users, marine macroalgae (Ulvales), were both put to the test in this study to evaluate potential natural remediation of this runoff issue. Replicated studies compared algal density to nitrate removal in a controlled setting. The idea was that this could help create a clearer picture of possible sinks for nitrate runoff in coastal waters. The near immeasurable amount of nitrate removal lead to a few conclusions ($p > 0.05$, $\alpha = 0.05$). The idea of species specific removal of nitrogen runoff is not new in the literature (Heathwaite and Johnes, 1998), and raises questions for future studies about whether capacity of natural sinks for human impact can be a product of what the algae have been conditioned to experience. They are possibly exposed to ammonium nitrate as opposed to NO_3, and selectively removing other species of nitrogen not as commonly found in fertilizer runoff thereby explaining the lack of nitrate removal here. The other possible future application of these findings lies in aquaculture, and the use of algae who are selectively removing chemical species in algae scrubbers to naturally balance aquarium tanks.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

EM ET EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count
250

Fair Category
LS

Project Number
3030

Title: Studies on the ecological effects of COVID-19 and its future implications on the emergence of disease, repercussions on habitats, and presence of wildlife

Student Name(s): M. Cheela

Abstract:

Beginning in December 2019, COVID-19 has forced many into their homes and out of their jobs. COVID-19 is an infectious disease that is spread through droplets when people cough or sneeze. Because of the pandemic, people have been forced to stay in their homes for several months. Although the coronavirus has devastated the world in terms of economic and social life, it has had a few positive effects as well, one of them being environmental. The purpose of this research is to analyze the effects of the coronavirus on the health of wildlife and its long-term effects on the environment. Through this research, scientists will be able to reevaluate environmental standards to effectively control climate change and other issues that plague the environment. To arrive at the results, I used a list of overarching questions to guide my research. Once I compiled my research, I made sure to cross reference with other sources to ensure my results are valid. If there were any discrepancies, I redid that section of the research. Through my research, I found that the COVID-19 pandemic definitely helped improve environmental conditions. Because of the coronavirus, wildlife has begun to reemerge in areas that were previously uninhabited. Additionally, air pollution levels have experienced a decline due to the lack of human activity. Not only air pollution levels have been affected, but so has light pollution and noise pollution. With fewer cars, buses, and trains, seismometers have begun to measure lower levels of vibrations.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   EV EA PS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents
☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: The Effect of Different Types of Media on Empathetic Behavior

Student Name(s): S. Hebbar

Abstract:

Elements in narrative fiction can foster empathetic development through transportation into a story. Transportation is when someone experiences high imagery, and is emotionally impacted. Components of empathy include empathetic concern, personal distress, fantasy, and perspective taking. The purpose of this experiment is to identify whether viewing a narrative fiction film or reading a short story lead to a greater level of empathy. The film and reading were based on the same story: "The Man Who Planted Trees" by Jean Giono. One group of college students received the fiction reading, another viewed the 30 minute film, and another read a nonfiction article about gentrification. Each participant answered some simple comprehension questions to confirm their understanding, and then assessed their empathy using different questionnaires. They played a round of dictator game to assess their prosocial life, completed a narrative engagement scale, an emotional engagement scale, and finally the interpersonal reactivity index which had four subscales, each measuring a separate component of empathy. So far data has shown that the fiction reading led to a higher measure of prosocial life, participants were more engaged with the film, and people gained more empathy for distress of others with nonfiction.

In today's day and age with more online interactions, it is important for people to be able to connect with others and grow healthy relationships. Film makers and story writers can also continue to develop their characters to encourage empathy through transportation, which can translate into real life behavior.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☒ human subjects ☐ potentially hazardous biological agents
☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: The Effects of a Bacillus and Trichoderma Inoculant and Lepidium Sativum on the pH and Microbial Recolonization of Low Intensity Burned Soil

Student Name(s): A. Hamza

Abstract:

This experiment examined the role that inoculants and plant growth play in soil recolonization after a fire. To answer this question, soil with an average pH of 5.35 was burned for 3 hours at low intensity. Sticks, leaves, and other organic material were placed on the soil for a steady fire. A week after the fire, unburned and burned soil were cultured. The soil samples were cultured again a week after the inoculant and Lepidium Sativum were placed in. The pH of both soils was taken 6 months after the fire and 20 days after the inoculant and Lepidium Sativum were in the soil samples. In general, burned soil had a greater microbial population than unburned soil. This pattern was also detectable after Lepidium Sativum and the inoculant were in the soil. Burned soil with Lepidium Sativum did not differ in pH greatly from burned soil with the inoculant. The same pattern was seen when comparing the pH of unburned soil growing Lepidium Sativum and with the inoculant. Burned soil continuously had more alkaline pH values. The overall microbial population of the burned soil was greater after burning and continued to dominate unburned soil samples regardless of being inoculated or growing Lepidium Sativum. With increasing fires worldwide, soil microbial populations will be greatly affected. Possible short-term solutions to aid low-intensity burned soil would be to add an inoculation to the soil. This might not apply to high-intensity fires which are more detrimental to soil substrate, fungi, and bacteria.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   EM MI PS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☒ potentially hazardous biological agents
☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Title: Tumor Reversion in Claudin-low Triple Negative Breast Cancer

Student Name(s): K. Kathir

Abstract:

Triple negative breast cancer (TNBC) is a clinically challenging disease that makes up approximately 12% of all breast cancers. TNBC is characterized by a lack of expression of the oestrogen and progesterone receptors as well as a lack of human epidermal growth factor receptor 2 (HER2) amplification. Expression in these receptors are commonly utilized in targeted and hormone therapies, but are ineffective for TNBC, limiting treatment options to aggressive chemotherapy and surgery. Within this group, claudin-low (CL) TNBC lacks basal markers and expresses low levels of claudin proteins and E-cadherin. CL TNBC has one of the worst prognoses of all subtypes due to its high chemoresistance and metastatic abilities. Tumor reversion, the process in which the cancerous cells lose their malignant phenotype, is often overlooked in cancer treatment. The objective of this project is to derive the genes that potentially control this reversion process to fuel a better treatment option in CL TNBC. Using RNA-Seq data in TNBC and normal cell lines, such genes were investigated. By utilizing bioinformatics tools to find the functionally enriched differentially expressed genes, their transcription factors, and upstream master regulators, a static core TNBC intracellular network was constructed. Further analysis through a systems control approach identified the genes driving the long-term behavior of the cells and genes that can potentially induce tumor reversion. These results not only show the appropriate genes for potential tumor reversion, but display how this type of structural analysis can yield promising candidates for targets in future cancer therapies.

**Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)**

CB ME

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Mispositioned Myonuclei likely contribute to Muscle Fatigue

Student Name(s): G. Armetta

Abstract:

Muscular dystrophies (MDs), characterized by progressive muscle wasting, are associated with 1 in 2,500 deaths in the United States. Although there are treatments that slow the progression, these disorders lead to early death usually due to cardiac or respiratory failure. Many muscle diseases are characterized by mispositioned nuclei within the muscle fibers that are thought to impair muscle function. It is unclear whether diseased muscles fail to function properly due to the inability of the affected myofibers to exert sufficient force, or if those muscles experience increased muscle fatigue more quickly. To address this question, we used Drosophila melanogaster, a model organism that is 60% homologous to humans, to more closely examine the locomotive behavior of mutant larvae. We either overexpressed or knocked down three critical genes known to be required for correct myonuclear positioning, Bsg25D, dmyc, and Ran, in the muscle tissue using the Gal4-UAS expression system to simulate instances of muscle disease. We then assessed the locomotive speed of the larvae and found that the muscle-impaired larvae not only moved slower, but they stopped more frequently than controls, suggesting that muscle fatigue is likely occurring. These data highlight an important distinction that has long eluded researchers and sheds light on the mechanisms that lead to muscle disease. With this information, we can now work towards identifying therapies, both genetic and physical, that specifically address improving muscle endurance instead of merely increasing a patient's range of motion to provide a better quality and prolonged life for affected individuals.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) CB MI ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Rapid, Noninvasive, Fluorescence-Based Detection for Elevated Levels of Nitric Oxide in Exhaled Breath, As a Marker for Hazardous PM2.5 Exposure

Student Name(s): A. Grover

Abstract:

There is a clear correlation between prolonged exposure to ambient fine particulate matter (PM2.5) and the development of lethal disease. Today, there exists no personalized, quantifiable measure to gauge an individual's exposure to PM2.5 other than generalized tools. PM2.5-induced constriction of lung airways leads to elevated NO levels produced in the lungs to fight inflammation. Accordingly, excess concentration of NO (40+ ppb in adults, 25+ ppb in children) can be a viable breath biomarker for the indication of PM2.5-induced lung inflammation. Herein, an inexpensive, portable, rapid, and temperature-independent breath detection kit for PM2.5 exposure was developed, based on smartphone-detection of NO-induced luminescence of DAF-2 (diaminofluorescein-2). Upon exposure to NO, DAF-2 is converted to highly luminescent DAF-2T (exc/em 485/530nm), which acts as a positive indicator for elevated breath NO levels due to PM2.5 exposure. To begin, 8 μl of 50ug/ml DAF-2 was embedded onto a filter-paper-based detection card, which was found to be stable when stored at room temperature (via repeated FTIR analyses). A linear relationship between 60ml of 0-1000ppb NO breath concentrations and DAF-2T detector illumination was established, first via surface-luminescence spectroscopy, and later with Smartphone images, taken with 490/560nm bandpass filters, for the flash and camera, respectively. A Smartphone application rapidly converts the detection card images (DAF-2 blank versus breath, NO-induced DAF-2T image) to green-color values, with a written algorithm determining the NO-breath concentration down to 10ppb. These results are time-stamped and shared, along with GPS coordinates, to build live PM2.5 exposure trends, at a per-test cost of ~$5.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) EN ME AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Which is the more efficient at bioremediating oil spills while factoring in salinity, algae, oil hungry

Student Name(s): A. Boudreau

Abstract:

I am doing this project because oil spills that occur in fresh water and marine environments are harmful to the organisms. I wanted to research if algae were a viable source to bioremediate oil spills in fresh water and marine ecosystems. I used various types of fresh water algae and 2 types of salt water algae. I wanted to see if there was any difference between the two types when it came to potentially remediating oil spills in freshwater and/or marine environments versus oil consuming bacteria. Based upon literature information I would predict that algae would be a better tool for the bioremediation of oil spills in freshwater environments. Centrifuge tubes were used. They were filled with water, oil, and the various algae, covered with plastic wrap to control water evaporation. Small holes were poked through he clear wrap to allow for aeration. The same procedure was used for the bacteria, with the exception that the cap was on, making it a closed system. Weight was taken on day 0 and again on day 15. Based on mass and the results of the hydrocarbon detection strips, the algae was able to break down the oil the best.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

EM PS MI

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☐ Yes ☒ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☒ Yes ☐ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☒ Yes ☐ No

CSEF Official Abstract and Certification

Word Count

250

Fair Category

LS

Project Number

3039

Title: Testing For Arsenic Contamination in Well Water, Municipal Water, and Agricultural Products

Student Name(s): S. Novak

Abstract:

Arsenic levels have been present in high levels in soil and water throughout New England due to both natural causes and man-made contamination. It is hypothesized that there will be higher arsenic concentration in agricultural products compared to municipal water and well water because if agricultural products are irrigated with arsenic contaminated water, then it will result in arsenic gathered in the soil and crops.   1. I first used the Hach testing kit to test for arsenic contamination in well vs municipal water. My variables were municipal and well water from New York, Connecticut and Maine. Second, I used the Chemsee testing kit to test for arsenic in agricultural products. My variables were Brown Rice, Apple Cider, Apples (red and golden), and distilled water. It was essential to liquidize each sample before beginning the experiment.   2. This is a completed project. I found that there was no arsenic present in the well and municipal samples. My hypothesis was supported that agricultural products would have the highest level of arsenic because Cortland apples and Uncle Ben's Brown rice had an arsenic level of 10ppb. These results show that the the state permitted level of arsenic (10ppb) and the filters are adequate and effective.   3. Although my samples did not go past the set arsenic level limit, I am curious as to what steps farmers/agricultural food sources can take to ensure that they have a clean irrigation system to facilitate the lowest level of arsenic possible in their crops/products?

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☒ Yes ☐ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☒ Yes ☐ No

CSEF Official Abstract and Certification

Word Count

170

Fair Category

LS

Project Number

3040

Title: An economically feasible application of germicidal irradiation to Personal Protective Equipment

Student Name(s): J. Fels

Abstract:

The purpose of this project was the development of a novel, economically feasible device capable of engendering germicidal irritation on bacteria cultures developed from used Personal Protective Equipment in economically underserved areas of the world. The procedure testing the device was conducted in two phases: bacterial control, and UVC implementation. In the former, individual pieces of PPE were inoculated with a K-12 strain of Escherichia coli, and then swabbed, with that bacteria cultivated and observed on a growth plate. In stage two, PPE was again inoculated with the strand, but then subject to 270 nm of UVC radiation via my apparatus. This process was observed at separate intervals of 5, 30, and 60 minutes. After exposure, the bacteria from the PPE was subsequently swabbed, cultivated, and observed and a comparative analysis against the control groups conducted. At the conclusion of statistical analysis, results indicate that this economical UVC irradiation apparatus is a feasible option for use of germicidal irritation on used PPE with the goal of reuse and sanitation.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) AT ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Optogenetic Stimulation of Neurons in the Brain to Treat Parkinson's Disease

Student Name(s): A. Bouton

Abstract:

10 million people worldwide suffer from Parkinson's Disease (PD). The root cause of PD is the degeneration of dopaminergic neurons, causing tremors and slowed movement. A current treatment for PD is deep brain stimulation, where a large hole is drilled into the skull to implant electrodes. However, this invasive process prevents older patients with PD from receiving this treatment. In addition, the drug Levodopa can cause dyskinesias. Therefore, a noninvasive method using light to treat PD was explored. Light can be used to stimulate genetically modified neurons expressing a light sensitive protein, therefore controlling their activity levels. It was hypothesized that the activity levels of genetically modified neurons can be modulated using light. To test this hypothesis, a test device that could grow neurons and record their activity levels was designed and fabricated, and neurons modified to respond to blue light were cultured. Blue light was used to stimulate the neurons, and yellow light was used as a control. Frequency and duty cycle were adjusted in between trials. The neuronal activity was then recorded and digitized, and Matlab was used to average signals and perform frequency analyses. It was found that blue light increased the activity of neurons and yellow light did not (p-value << .001), and the test device could measure these changes. These findings can be applied to human models of PD to stimulate dopaminergic neurons, therefore improving motor functions. In addition, since optical stimulation is noninvasive, it may be a preferred treatment for PD in the future.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) ME EN

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☐ Yes ☒ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

CSEF Official Abstract and Certification

Fair Category

Project Number

224

LS

3042

Title: What do seasonal Multiple Sclerosis development patterns indicate about the disease, and

Student Name(s): R. Vipparla

Abstract:

A study in Australia investigated whether there is a link between the risk of developing MS and the month that people are born in. Thus, the question being addressed in the study is "What do seasonal Multiple Sclerosis patterns tell us about the disease and how can we use this information to reduce the influence of environmental factors?". I hypothesis that a significant factor causing summer babies to develop Multiple Sclerosis later on in life is their lack of exposure to vitamin D. In this study I am isolating different aspects of the question and research them individually, using resources from textbooks, websites such as "MS Society", and non previously published data, writing down findings and draw conclusions based on the information collected, and calling experts in the field of neuroscience to discuss findings from the textbooks/websites and check accuracy with them. By conducting the research, I was able to conclude that my hypothesis was correct as summer babies are more likely to develop Multiple Sclerosis because a majority of time they spend in the womb is during the winter seasons, which have less sunlight. The decreased amount of sunlight, is directly correlated to a decreased amount of Vitamin D. This lack of vitamin D while babies are developing is what results in an increased chance of developing MS in their later years.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   ME EV BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No
4. Is this project a continuation? ☐ Yes   ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count
248

Fair Category
LS

Project Number
3043

Title: The Effect of Applied Glucose on Moisture Retention and Survival of Saplings After Simulated Forest Fires.

Student Name(s): R. Finn

Abstract:

Forest Fires are a serious threat to wildlife, leading to lasting changes in ecosystems by burning trees and affecting soils' water retention properties. As seedlings require moist soil, a solution is crucial to survival. It is hypothesized that introducing glucose to burnt soil will improve water retention and subsequently increase the survival of seedlings.   Eight groups of 300ml of burned soil were separated into pots. Each pot received a boxwood seedling; two pots were marked as controls with no glucose treatment. The remaining pots were separated into two groups, one group received one glucose treatment, the other received glucose every two weeks. The treatment included 0.5mg of glucose per g of soil, 2.0mg/g, and 5mg/g. The addition of 2mg of glucose per gram of burnt soil was associated with the longest survival time of 5 weeks. All other plants that received glucose did not survive as long compared to the 2mg/g treatment, but all survived longer compared to the control group.   These results show that an excess of glucose will prevent water from filling the nanopores while not enough glucose will prevent water from attracting to the nanopore. Limitations of the study include lack of time to perform a second trial and lack of a real forest fire. Further testing will need to be done to confirm my preliminary results. In conclusion, these results suggest that glucose can aid in the regrowth of dry ecosystems, like the Western United States, that never recover from fires.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

PS EV CB

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No
4. Is this project a continuation? ☐ Yes   ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Title: Allelopathic Effects of Invasive Species Garlic Mustard (Alliaria petiolata) on Germination of Black-eyed Susan (Rudbeckia hirta)

Student Name(s): L. Marze

Abstract:

Allaria petiolata, also known as garlic mustard, is an invasive plant that has quickly become established as a noxious weed in North American forests. Previous research has shown that allelochemicals secreted by the plant can reduce the germination of competing plant species and condition soil to inhibit new native plant growth. This research studied the effects of four garlic mustard plant tissue and root system soil treatments on the germination of black-eyed Susan (Rudbeckia hirta) seeds. The four groups, including a control with no treatment, were soil treatments with (A) fresh plant material, (B) dried plant material, (C) burned plant material, and (D) aqueous plant extract. The control group was found to have the highest average seed germination, while the extract treatment group was found to have the lowest average germination. The dried and burned plant material treatment groups were shown to have little allelopathic impact on the seeds. This suggests that established methods of garlic mustard disposal, such as controlled fires and removal before seed production, effectively eradicates the species and mitigates its allelopathic impact on native flora. There was sufficient evidence to suggest that the fresh plant material treatment group data was significantly different from the control group data, indicating that the treatment had the greatest success in inhibiting the germination of black-eyed Susan. These findings suggest that Connecticut garlic mustard has a negative impact on black-eyed Susan and that this invasive must be studied further to determine its influence on Connecticut's flora.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) PS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Exercise Therapy to Treat Anxiety: The Effect of Running on Anxiety Levels

Student Name(s): A. St. Jean

Abstract:

Anxiety is a mental health disorder affecting 31% of US adults at some point in their lives. While pharmacotherapy and psychotherapy are effective in treating Anxiety, neither treatment is accessible to the entire population. Alternative treatments for Anxiety have been recently introduced, including exercise. This study is designed to measure the Anxiety levels of runners before and after their runs to determine whether running has an impact on Anxiety. It was hypothesized that running will have a positive effect on reducing Anxiety levels in runners. To measure this, each participant submitted a survey before and after they ran. The Zung Self-Rating Anxiety Scale (SAS) was utilized to calculate Anxiety levels before and after running. Self-reported data such as age, gender, frequency of exercise, time run, mileage, and pace was also collected. For 4 participants (n = 7), running had a positive effect on reducing Anxiety levels ($p < 0.05$). Further, Anxiety level changes are not impacted by age ($p = 0.39$) or frequency of exercise ($p = 0.18$). Additionally, average time run ($r = 0.37$), average mileage ($r = 0.16$) and average pace (minutes/mile) ($r = 0.28$) are not correlated with Anxiety level changes. This research brings forth a potential for larger scale studies, implicating the possibility for lower income adults without access to expensive treatment, to treat their often debilitating Anxiety. Additionally, little to no research, to my knowledge, has been done focusing on the impact of specific exercises on anxiety.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   BE ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☒ Yes   ☐ No

Word Count

241

Fair Category

LS

Project Number

3046

Title: Ocean Acidification: How it Effects the Phytoplankton Species Nannochloropsis Oculata

Student Name(s): A. Hatfield

Abstract:

Since the industrial revolution 200 years ago the ocean's pH has been dropping steadily as more carbon dioxide gets absorbed into the ocean. From this experiment, the potential effect of ocean acidification on the species Nannochloropsis oculata was observed. For twenty-two days three phytoplankton cultures were kept at pH levels of 6.0, 6.1, and 6.2, and chlorophyll a was monitored using a fluorometer. At the end of the exponential growth period of the cultures (at day 19), the chlorophyll a levels in the culture with a pH of 6.0 was at 17024 ug/L (35.76% overall growth), the culture with a pH of 6.1 was at 24120 ug/L (153.47% overall growth), and the culture with a pH of 6.2 was at 27784 ug/L (171.22% overall growth). Because chlorophyll a is an indicator of population size in plankton cultures, this demonstrates that the population of the lowest pH flask was the lowest of the three flasks, and the population of the highest pH flask was the highest of all the flasks. This demonstrates how, although the cultures still experienced significant growth under strenuous environmental pH, as the pH of a culture decreases the population of a Nannochloropsis oculata will experience a decrease as well. This implies that ocean acidification could harm the population in the environment and because phytoplankton are the basis for all oceanic food chains this negative effect on specific phytoplankton populations could destabilize entire marine ecosystems.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

EV EM MI

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

251

LS | **3047**

Title: Extensive Look Into the Rising Maternal Morality of African American Women and the Factors Behind It

Student Name(s): L. Lawson

Abstract:

The number of women dying by labor and pregnancy complications in the U.S. is alarming. What is worse is the disproportional rate black women are dying compared to their counterparts. Many studies have alluded to racial disparities and misinformation in the medical community. In an attempt to 'challenge' these claims, I constructed my project to see if such factors were prevalent in my community. I hypothesized that if it is statically known that African American women face a higher chance of maternal mortality in the United States, then there must be non-extraterrestrial factors that are contributing to its rise. In my survey, I included participants of different races to show the contrast of 'racial disparity. Participants were subjected to answer questions regarding aspects of pregnancy. From evaluating and analyzing the data, I found there was a mix of conflicting answers that did not show a definite racial disparity amongst African-American women compared to their fellow counterparts. When asking if they believed they received good treatment regardless of "race", 80% of black participants replied "no", while 20% of non-black participants said "no". However, when asked to rate the "openness" of their doctors, all black participants ranked high numbers while one more non-black participants ranked low. My hypothesis was not fully supported by my data and could be because of my small sample size. This study and its outcomes are the beginning steps towards resolving the issue of maternal mortality overall. It calls for more focus on patient treatment.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

BE   ME

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

Word Count

249

Fair Category

LS

Project Number

3048

Title: Leading By Example: Analyzing How Different Countries Have Committed to Net-Zero Carbon Emissions and What Can Be Taken From Their Progress to Guarantee Efficacy and Efficiency

Student Name(s): C. Zhu

Abstract:

Climate change has been an ever more concerning issue as the change in global temperature begins to approach what will be, a devastating, 1.5 degree Celsius difference, in comparison to industrial times. The United States has recently reentered the Paris Climate Agreement, however how the U.S. will reach its goal of reaching net-zero in carbon emissions by 2050, is still uncertain. With the preparations and progress made in other countries that have also committed and aimed to reach carbon neutral within the next few decades, it leaves many possible solutions to be analyzed. By comparing ten countries by their annual and projected greenhouse gas emissions (measured in metric tons of carbon equivalent, excluding forestry and land use), gross domestic product growth (GDP), the percent composition of renewable energy out of the total energy sector, and policies implemented, comparison and analysis can be made on how effective and practical each policy/plan has been and will be. It can be concluded that the U.S. has the ability to reduce its greenhouse gas output and ensure growth in the economy, if the country continues to convert and rapidly develop its renewable energy sector, reduce dependency on natural gas, and implement decarbonization techniques. Such decarbonization techniques would strictly monitor and limit the energy consumption of the largest industries. The transition will be a costly project, as reflected in the budget of other countries, however, in order to prevent further environmental and economic disaster, the costs will turn into an important investment.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count

212

Fair Category

LS

Project Number

3049

Title: Can Orange Peels help plants to grow?

Student Name(s): A. Smith, A. Smith

Abstract:

My research project was on plants behaviors to orange peels. Many people buy oranges and throw away the peels in the bin when they could be used for something else. I decided to see if instead of throwing the peels away, could they be used in gardens because many people have gardens. I decided to use two red beans for each of the 2 cups. So, I could keep track of the heights on both types of soil- one without orange peels and one with orange peels. I planted two seeds in the orange peels soil and he other two in the soil without peels but both soils being topsoil. All four seeds were planted on the same day and recorded data went to the 23rd of December. My beans in the peel soil did not grow or even germinate but my soil without peels grew 11 inches on the 23rd. I concluded that some plants like red beans have a low ph intolerance meaning they can't tolerate too much acids and stops them from germinating. Since orange was a citrus fruit the peels had limonene in it that would keep pests away but had acid. But plants like bunchberries and rhododendrons can tolerate acid, so they can grow with orange peels.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

PS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents
☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No
4. Is this project a continuation? ☒ Yes   ☐ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count
259

Fair Category
LS

Project Number
3051

Title: Analysis of COVID-19 Treatment Options- Ayurvedic and Allopathic : Possible Combination Therapy Design

Student Name(s): M. Chhatre

Abstract:

The COVID-19 pandemic has impacted the world, and currently there is no definitive treatment option. This project focuses on various existing allopathic and ayurvedic medicines being repurposed to develop a potential combination therapy for COVID-19. After initial research on COVID-19 and the SARS-CoV-2 life cycle including mode of host cell entry, this study focused on allopathic and ayurvedic drugs that are in clinical trials or used for COVID-19 treatment. The Allopathic drugs studied typically inhibited an aspect of the virus life cycle, stopping SARS-CoV-2 replication, but cause adverse side effects. The Ayurvedic medicines studied targeted the body's immune system and built up the overall health, in addition to blocking viral propagation. Furthermore, Ayurvedic medicines often have fewer side effects if any unlike their allopathic counterparts. Based upon the actions of both Allopathic and Ayurvedic drugs, the project proposed combination therapies that would draw upon both types of medicines, to optimize the COVID-19 therapy while minimizing the side-effects. One of the potential therapies developed was allopathic Remdesivir and ayurvedic Ayush Kwath. Remdesivir interrupts RNA polymerase which would inhibit the virus' replication, while Ayush Kwath would mitigate Remdisivir's side effects of nausea, dizziness, stomach pains, and more, and be immunoregulatory. Together the two can form a successful combination therapy. Due to the theoretical nature of this project, future goals include testing the potential therapies at a clinical trial level and building upon them to develop even more effective treatment options, such as even developing a new molecule based upon these therapies.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)
ME MI BI

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

251

Fair Category

LS

Project Number

3052

Title: Evaluating the Intraspecific Relationship and Reciprocal Reaction Within Group Learning Shark Behavior Patterns.

Student Name(s): C. Nyiri

Abstract:

The goal of this study is to teach the practice, target training, to a single Mustelus canis (Mud Shark) and then determine if subsequent introduced sharks will interact and learn the practice from the initially trained shark, to evaluate the learning cascade. An initial goal is to successfully train one shark using a static target food reward allowing for the measurement of the time required for target acquisition and attack angle. This process is repeated until all daily food allotments are consumed. It is anticipated that once target training is completed the introduction of subsequent individuals will be used to determine if the social learning cascade can be realized. Data being recorded is the amount of time it takes for an interaction to occur with the static target and reward. Also, attack angle is being recorded for recognition of feeding patterns. Over 16-trials the initial shark was successfully trained with a 78.33% increased learn rate. The R-Value concluded at 0.3386, however the significance of F was 1.8%. This provides the necessary foundation to conclude that the trials and times were correlated. The untrained shark was then brought into the tank with the trained shark was. Data was kept on the interactions and reaction times. Over 7-trials, the introduced shark interacted with the target 11.90% of the time resulting in success for the study. This data can be applied as a foundation to future research regarding shark-human interaction in future studies/research, such as multi-generation migration patterns.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

BE AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☒ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
227

Fair Category
LS

Project Number
3053

Title: The Effect of Artificial and Natural Lighting on Dinoflagellate Growth and Bioluminescence

Student Name(s): S. Nieves

Abstract:

Bioluminescence has been an interest to humans for centuries, and we have finally gotten a better grasp on the topic. Today, many scientists are using bioluminescent creatures to help with life saving procedures in neuroscience and more. Thanks to the natural chemical reaction, we are able to light up more of the body to detect and visualize things we couldn't have in the past. Understanding the best living conditions for these helpful creatures could prove useful, as we rely on their glow to show us the unthinkable. What exactly is the best way to culture and care for these creatures to get the best chemical reaction? My project for the CT Science fair revolves around the bioluminescence of Dinoflagellates, specifically Pyrocystis Lunula. I will be changing the amount of light, along with the type of light given to my dinoflagellates and observing the amount of light produced, and how long they continue to glow until dying out. The dinoflagellates I am using were shipped from Carolina science, where they are given light from a LED bulb. There's no data I have as of right now, as my materials have just arrived to me on the 27th of February. However, I can hypothesize that the cultures will be the healthiest and brightest with natural light rather than artificial light, as it is closest to it's natural living conditions.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   CB BI EV

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count

246

Fair Category

LS

Project Number

3054

Title: Surveying Adolescent Public Opinion and Knowledge on Nuclear Energy

Student Name(s): E. Connolly

Abstract:

Since nuclear energy was first used in the 1940s, the public has been divided in their views of the way it should be used. Today, great advances have been made in the use of nuclear energy, particularly fusion. It was hypothesized that most people surveyed will not know much about nuclear fusion and will show more opposition to nuclear fusion than support. The electronic survey was created and IRB approval was obtained. The survey, using the Likert scale, collected information about people's views on nuclear energy focusing on nuclear fusion. It was administered over Google Forms and was anonymous, asking only general information such as age and gender. The survey was administered to students within the Sacred Heart Network in the United States and approximately 200 students participated. Results demonstrated that most adolescents surveyed lacked knowledge of nuclear fusion. This was indicated by a question that asked if students wanted to know more about nuclear fusion, and 72.8% either agreed or strongly agreed with this statement. Also, a question asked if students felt they had enough knowledge to properly complete the survey, and 59.2% either disagreed or strongly disagreed. This survey updated public opinion on nuclear energy and get specific information on the public's, specifically adolescents', perception of fusion energy. My hypothesis was correct as the survey results demonstrated there was a lack of information. Advances have been made in the use of nuclear energy, particularly with fusion, and greater public awareness and education are needed.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

BE

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☒ Yes ☐ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Testing For the Presence of Antibiotics in Poultry

Student Name(s): G. Coale

Abstract:

Antibiotics have been used in the past for every phase of the chicken-raising process, however, many poultry products today are labeled antibiotic free. The purpose of this study is to determine if the products are indeed antibiotic free. This is significant because antibiotics in poultry can lead to drug resistance in humans. It is hypothesized that at least 40 percent of poultry will contain antibiotics, even if labeled antibiotic free. To test for the presence of antibiotics in poultry, the PremiTest was used in several trials of popular and supermarket brands of poultry. A positive control, the antibiotic penicillin, and a negative control, poultry known not to contain antibiotics, were also tested. The independent variable is the type of poultry product tested, and the dependent variable is the presence of antibiotics. There has been a significant amount of mislabeling detected, meaning antibiotics were found in products that were labeled antibiotic free. Antibiotics were also found in products that did not indicate whether the product contained antibiotics. Overall, 50 percent of the 22 samples tested contained antibiotics, thereby supporting the hypothesis.This study will help raise awareness and help educate consumers when buying different poultry products. There were, in fact, antibiotics present in poultry products that do not have antibiotic information on the label or that were labeled antibiotic free, demonstrating that the consumer needs to be aware of the issue. An avenue of research that could be explored next is how the products that are labeled antibiotic free are contaminated.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   ME AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No
4. Is this project a continuation? ☒ Yes   ☐ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count
252

Fair Category
LS

Project Number
3056

Title: Synthesis and Evaluation of Recombinant Therapeutic Antibodies for Metastatic Breast Cancer

Student Name(s): N. Azimov

Abstract:

Lifetime risk for women to be diagnosed with invasive breast cancer is currently 1 in 8 in the US, accounting for about 250,000 new diagnoses per year. Metastatic breast cancer (MBC) accounts for about 6% of total first diagnoses. To target invasive and MBC that has spread, monoclonal antibodies (mAbs) may be used as a systemic treatment to target multiple lesions. To target metastatic tumors, mAbs must recognize the tumors' cell surface antigens (CSAs). My mentor is developing an antibody, identified from a sentinel lymph node of a breast cancer patient, which specifically targets the CSAs of aggressive tumor cells. To optimize the therapeutic potential of this mAb, we investigated whether variant light chains might improve tumor CSA targeting, thus improving the immune response to metastatic tumors. In conducting research, extensive online searches were used to understand laboratory experiments and procedures performed by my mentor, and for determining procedures used. This entitles garnering information to determine the most efficient mode for transfecting cells, purifying recombinant mAbs, and quality control. Antibody cancer targeting efficacy was analyzed through multiple experimental models, including antibody-cell flow cytometry and immunofluorescence data, produced by my mentor. These results indicated that the antibodies recognize CSAs on aggressive tumor cells, and that light chain variants also demonstrated targeting. To distinguish optimized antibody targeting, directly testing each variant using functional assays is currently underway. These studies indicate that this patient-derived antibody, with specific light chains, may be an exceptional therapeutic against MBC and reduce mortality for this terrible disease.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
254

Fair Category
LS

Project Number
3057

Title: Escherichia coli Utilizes the Fe3+ ion for Protection Against LL-37-Mediated Membrane Permeabilization

Student Name(s): J. Winterlich

Abstract:

In 2012, there were approximately 12 million global cases of tuberculosis, including 1.3 million fatal cases. Additionally, in 2016 there were 10.4 million new global cases, 600,000 of which were resistant to Rifampicin, one of the most powerful first-line drugs in use. Bacteria are becoming increasingly resistant to widely-used multidrug treatments; thus, the need for new antibacterial treatments is imperative for treating bacterial infections effectively. One solution to this problem is the use of antimicrobial peptides (AMPs), which are part of the innate immune system response to bacterial infection. We previously identified that the primary mechanism of action of the human AMP, LL-37, is to permeate the bacterial membrane, but the effects of the bacterial environment on the efficacy of the peptide remain unknown. We investigated the efficacy of LL-37 against E. coli, a model for tuberculosis infection, in the presence and absence of Fe^{3+} ions and found that LL-37 demonstrated a greater bacterial elimination in the absence of Fe^{3+}. We then determined that the presence of free ferric ions restricts the efficacy of LL-37 to permeabilize the bacterial cell membrane. Furthermore, we sought to identify the potential benefits from adding an iron chelator, deferoxamine, to LL-37 to create a versatile treatment method. Collectively, these data reveal that E. coli utilizes free ferric ions to prevent membrane lysis, which causes reduced peptide toxicity. With further investigation into LL-37 efficacy, the likelihood of identifying a cure for tuberculosis will increase, ideally reducing the number of tuberculosis fatalities.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) MI CB BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents
☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes   ☐ No

4. Is this project a continuation? ☒ Yes   ☐ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

Title: The effects and trends of genes and their association to diseases and how certain environmental factors may play a significant role.

Student Name(s): S. Gudlavalleti

Abstract:

During past years, it is evident that environmental factors may influence genes and cell proliferation which can cause illness. The purpose of this research was to understand the importance and know how different environments will alter and affect genes. Prior to beginning this research, the hypothesis was that due to differences in everyone's genes, environmental factors will affect everyone a little differently. To come to my conclusions, I used multiple questions to guide my research. I used multiple sources to make sure the data I collected was accurate. Through my research I was able to come to the conclusion that the environment factors have a significant impact on genes. The specific location of the gene that is primarily affected by environmental factors is the epigenome. The epigenome is responsible for normal cellular processes and changes to it are a natural part of human development however some changes caused by environmental factors can lead to diseases. One specific environmental factor that was researched was ultraviolet radiation from the sun which exposure to that can cause cancer. I was able to conclude that the changes to the epigenome is the primary reason for diseases caused by the environmental factors. This is why environmental factors are important to consider because of the impact that they can make on a person's genes.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   ME EV BE

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Studying the Behavior of Dogs in Relation to COVID-19

Student Name(s): I. Griffith

Abstract:

When it comes to dog behavior, it is a common topic of research today. However, a global pandemic recently hit the world, bringing many unknowns into the playing field. The question at hand is whether or not during these unprecedented times, dogs have changed their behaviors because of abrupt routine changes or more stressful environments. A google form was created with various questions that people across the state, country, and world had the ability to fill out for a period of time. These questions consisted of ones that asked about observations of their dog's behaviors and any noticeable changes that have occurred since March of 2020. This form was posted to various groups on Facebook and sent out through email. The dogs with the greatest changes in their daily routines were found to have behavioral deviations such as increased aggression, sleeping for longer periods of time, lack of appetite, etc. Additionally, the dogs with the least amount of change due in part to the pandemic had the fewest shifts in behavior. The research that was performed is important to better understand animals that are prominent in many people's lives today. These findings can also bring change to how dog training works because it can allow for trainers to work with dogs in high stress situations that could be encountered in their environments. Additionally, understanding how stress during times like these affects canines is crucial to improving their quality of life.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   AS BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☒ Yes ☐ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count

252

Fair Category

LS

Project Number

3061

Title: Elucidating the Role of Alternative Splicing in Metastatic Osteosarcoma

Student Name(s): S. Ghoshal

Abstract:

Osteosarcoma is a cancer which originates in the bone. IRX1, a gene that is heavily overexpressed in metastatic osteosarcoma, may provide insight into the regulatory pathways that become disrupted during metastasis of osteosarcoma. This project aims to further elucidate the role of IRX1 in metastatic osteosarcoma through network analysis of data obtained through public databases. By cross referencing datasets from GEO, KEGG, STRING, TF2DNA, and Enrichr, we created a novel network of proteins involved with IRX1 in metastatic osteosarcoma, including DLX2, SOX9, SHH, FOXJ1, SMAD3, CXCL14, SRC, AKT, PIK3CA, HEY2, SOX2, IKBKB, NF-KB, and AKT. We propose that IRX1 could play a key role in regulating the Notch pathway through activation of ASCL1, which in turn activates HES1 (a product of the Notch pathway), and through a negative feedback loop, will eventually inhibit IRX1's expression. Furthermore, we predict that the Notch pathway is actually directly linked to a chemokine signaling pathway through IRX1 and HES5. Both of these proteins activate CXCL14, the ligand which triggers the pathway, and eventually leads to the expression of NF-kB, a protein essential for regulating apoptosis, cell survival, and cell proliferation. Because Notch and the CXCL14/NFkB pathways are essential to activating invasion and metastasis, disruptions in its normal function as seen in osteosarcoma can have deadly and cancerous effects.

By analyzing which gene networks are more altered in the tumorigenic process, we can better understand how osteosarcoma tumors turn metastatic, paving the way for new targeted treatments- advancements much needed for cancer patients.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

CB

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2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
146

Fair Category
LS

Project Number
3063

Title: The Effects of Chemical Lightening on Hair Tensile Strength

Student Name(s): D. Drye

Abstract:

The purpose of this lab was to observe the effects chemical lightening had on the tensile strength of hair strands by chemically saturating three strands for different amounts of time and measuring how much weight they could support in grams. It was hypothesized that a longer saturation period would result in a lower tensile strength. A device was created that allowed pennies to be placed in a bag attached to the hair strand. Pennies were continually added until the hair strand broke. It was discovered that chemical lightening treatments resulted in lower tensile strength. Thus it was concluded that the longer the treatment was, the lower the hair strand's tensile strength was. Based on the results in this lab, the next step in this study would be to use a microscope and observe the physical structure of a hair strand in correlation to chemical lightening treatments.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   BI

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☐ vertebrate animals   ☒ controlled substances

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

243

Fair Category

LS

Project Number

3067

Title: Determining the Proliferation of Cellular Oxidative Stress through Blue Light Induced ROS Formation

Student Name(s): G. Silva

Abstract:

There exists a divide within the scientific community about whether the effects of blue light radiation are detrimental or not. Research suggests that blue light exposure may play a role in development of visual issues such as macular degradation and cataract formation, but a lack of evidence leaves the question of what cellular mechanisms cause these issues. It has been reported that blue light exposure may cause intracellular reactive oxygen species (ROS) overproduction, which can lead to cell damage. A better understanding of the exact cellular mechanisms that cause these health issues may lead to a more effective prevention or treatment.

This experiment aims to determine if blue light causes the production of ROS within cells, which would signify that it causes cell damage. Yeast, or Saccharomyces cerevisiae, is cultured and subjected to blue light radiation for one hour and H2DCFDA, a fluorogenic reagent, is used to determine ROS levels. In order to keep the concentration of yeast cells constant throughout samples, a ten microliter inoculating loop is used to suspend cells in distilled water, and cell concentration in each sample is calculated using an equation that estimates cell concentration per milliliter from absorbance measurements. H2DCFDA fluoresces when it binds with intracellular ROS, and the greater the fluorescence the greater the level of ROS. The fluorescence of yeast cultures, both subjected to blue light and not, is recorded and compared to determine if blue light had any effect on the production of ROS.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) ME BI CB

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☐ vertebrate animals   ☐ controlled substances

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3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No
4. Is this project a continuation? ☐ Yes   ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count
246

Fair Category
LS

Project Number
3068

Title: CO2 Emissions to Polar Bears: How Reducing CO2 Emissions Can Save the Ursus Maritimus

Student Name(s): A. Van Gelder

Abstract:

The current increase in CO2 emissions is causing many problems, including a decrease in the amount of sea ice. This decrease is a leading factor in the decline of the polar bear population, as the lack of ice fatally impairs their ability to hunt. Decreasing CO2 emissions through the use of renewable energy will slow the reduction of the polar bear population. Using data predictions taken from IRENA for the future of CO2 emissions, the ever-increasing rate of decrease in the polar bear population will be reduced by over half of the current predicted rate of decline. Future CO2 emissions were predicted based on current trends and reduced by 60% over a 30-year period. The rate of decrease of sea ice was found from average maximum extents and continued into the future. With the relationship between predicted CO2 emissions and the decrease in sea ice, a new relationship between the two was found when CO2 emissions were reduced. Using the predicted 30% decrease in polar bears globally, the current population was decreased by 30% over 30 years. Continuing the relationship between decreased emissions and sea ice allowed for an accurate prediction of a decrease in polar bears by 2050 when renewable energy is used. The results showed that by use of renewable energy resources decreasing CO2 emissions by 60%, then sea ice will face a 2.702% decrease and there will only be a 12.02% decrease in the polar bear population by the year 2050.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) EA EM EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count

254

Fair Category

LS

Project Number

3069

Title: Evaluation of a Model for Urban Vegetation Barrier Effects on Air Pollution

Student Name(s): R. Nassar

Abstract:

Air pollution is a serious global issue, responsible for approximately one in every nine deaths each year, ranking it among the greatest environmental hazards to human health. It is of particular concern in urban areas, where elevated pollutant concentrations and potential sufferers converge. Over one half of the world's population presently lives in urban areas, and the urban population ratio is expected to reach 68% by 2050. Common air pollutants include particulate matter (PM), sulphur dioxide (SO_2), ground-level ozone (O_3), nitrogen oxide (NO_x) and carbon monoxide (CO). While elevated rates of air pollution pose serious health risks for humans, outdoor plants can help reduce the harmful effects of air pollution by filtering and purifying the air around us.

In this project Common Ivy, Aster and Miniature Andromeda plants were evaluated for air pollutant mitigation. In this study we developed a vegetation barrier model with the plant located in the middle of the greenhouse box, and air pollutant was sprayed on one side of the plant. Dispersion patterns of sprayed pollutants were tested with and without vegetation barrier. Measurements of carbon dioxide (CO_2), Formaldehyde (HCHO), Total Volatile Organic Compounds (TVOC), and Particulate Matter (PM2.5/PM10) were taken before spraying, then at 0 and 30 minutes after spraying, using both monitors.

The results show mitigation rates (in 177 ft3 of air after 30 min): for TVOC the minimum reduction is 5 mg/m3; for HCHO, 1 mg/m3; for CO_2, 2000 ppm; for PM2.5, 2000 ug/m3; and for PM10 it was 1000 ug/m3.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   PS EV BI

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
254

Fair Category
LS

Project Number
3070

Title: Proteomic Analysis Reveals Novel Biomarkers for Type 2 Diabetes

Student Name(s): M. Wang

Abstract:

Diabetes is a chronic metabolic disease associated with metabolic disturbances of carbohydrates, proteins, and lipids. Robust efforts have been made to strengthen the healthcare systems for the diagnosis and management of diabetes. However, it remains a medical dilemma how to effectively monitor and manage diabetes. At present, blood glucose and hemoglobin A1C are gold standard biomarkers for the diagnosis and management of diabetes. The values of blood proteins in monitoring the occurrence and progression of diabetes have not been well explored. To fully understand the biological changes in the blood of diabetic patients, we recruited 60 participants including 30 healthy adults and 30 patients diagnosed with type 2 diabetes. By performing deep profiling of proteomes in the blood, we identified a total of 42 proteins that are differentially expressed in the blood of diabetic patients compared with healthy controls. Of the differentially expressed proteins, α2-macroglobulin, L-selectin, APOA1 and APOD are most significantly elevated in diabetic patients, which could serve as a more sensitive combinational biomarker in distinguishing diabetic patients from healthy people and may predict the progression of diabetes. Furthermore, through analyses of gene ontology and Kyoto Encyclopedia of Genes and Genomes pathways associated with the differentially expressed proteins, we discovered that the activation of liver X receptors/retinoid X receptors in diabetic patients was a key biological event that can trigger the dysregulation of cholesterol, lipid, and glucose metabolism. Collectively, our study provides a rich and open-access resource to shed lights on personalized precision approach for optimal management of diabetes.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)
ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects ☐ potentially hazardous biological agents
☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: The Roles of Gene Expression of Non-Homologous End Joining in the Progression of Ovarian Cancer

Student Name(s): E. Lavi

Abstract:

DNA damage is repaired by the cell in multiple ways. When the main pathway is unavailable, the cell resorts to its backup, Non-Homologous End Joining (NHEJ). Causing a high level of mutations, NHEJ can both lead to cell death or the development of resistance to therapies, which decreases the chance of a patient's survival. It was hypothesized that NHEJ gene expression can predict prognosis in ovarian cancer patients. A literature search identified 48 genes involved in NHEJ. Data from 651 ovarian and breast cancer patients were extracted from the Cancer Genome Atlas. A neural network was programmed to analyze complex data patterns, with the goal of predicting prognosis. The model was trained on 332 ovarian and 274 breast cancer patients. The breast cancer patients were added to augment its learning. The trained model was then tested on a separate set of 45 ovarian cancer patients. A feature importance analysis was conducted to determine the genes most important to the achieved accuracy. Compared to random predictions, the machine learning approach showed 22% higher relative accuracy. In the feature importance analysis, genes EXO1 and TP53BP1 of the 48 stood out as most important to the predictions. These findings support the hypothesis that the NHEJ gene expression in ovarian cancer is a possible biomarker of tumor mortality. The accuracy of the model could be increased by including other variables such as demographics or tumor stage. Further inquiry is required to evaluate the potential clinical applications of the two genes identified as most important.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) ME CS

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count

252

Fair Category

LS

Project Number

3072

Title: Efficacy of Dissolved Flavonoid Supplements in Chelating Iron (II) in a Solution

Student Name(s): P. Gagnon

Abstract:

In the Alzheimer's Disease research community, the dysregulation of iron is widely accepted as one of the probable causes of Alzheimer's Disease. Multiple studies have shown that early in the progression of Alzheimer's Disease, before obvious mental symptoms arise, there is a buildup of excess iron in the liver, eyes, and brain. However, many early-onset Alzheimer's Disease patients are diagnosed with iron-related anemia, suggesting that iron is not being properly circulated through the bloodstream. Natural chelating agents such as flavonoids, a chemical produced by plants to protect against environmental stressors, can be very effective in regulating the circulation of iron. Many researchers believe that the key to slowing or even stopping the progression of Alzheimer's Disease may be finding what the perfect daily dose of flavonoids is. In my research, I tested the ability of four different flavonoids to bind to the free iron in an aqueous solution to determine which was the most effective. After combining the flavonoid and free iron in one solution and allowing them sufficient time to bond, I was able to test the amount of unused flavonoid in the solution by using a spectrophotometer, which measures the concentration of a solution by shining a beam of light through it and calculating the amount of light absorbed by the solution. After testing each flavonoid, I determined that quercetin was the most effective in binding to the iron because it had the least amount of unused flavonoid remaining, meaning that more free iron was bound to it.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

BI CH ME

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4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Identification of Epigenetic Determinants of Cell FatE

Student Name(s): S. Xu

Abstract:

Cell fate is determined by its genome and the epigenome. The study of cell fate can create new treatment methods to control the development of disease cells. Zebrafish stripes are formed by pigment cells -- melanocytes and iridophores -- that have different phenotypes despite having the exact same genome. This project aims to identify the epigenetic events that drive pigment cell fate decisions.

DNA methylome, chromatin accessibility, and gene expression profiles of zebrafish neurocrest cells, melanocytes, and iridophore, were generated using technologies such as whole-genome bisulfite sequencing, ATAC-seq, and RNA-seq. They produced large amounts of next-generation sequencing (NGS) data. Bioinformatics approaches analyzed the data and identified differences in chromatin accessibility associated with differences in gene expression between melanocytes and iridophores. Commands written in batch programming language manipulated the sequencing data. Mapped reads were then used to call peaks which represent open chromatin regions that could serve as regulatory elements such as enhancers. Results were visually examined on the WashU epigenome browser and compared to identify enhancers around genes such as Pnp4a, Gbx2, and Mitfa.

I identified peaks that signify that there is a larger amount of Melanocyte or Iridophore expression. There are varying levels of gene expression, and it can clearly be seen the areas of accessible chromatin have higher levels of expression.

From the research, it is clear to see that the open chromatin is strongly associated with high gene expression. When bound to proteins called transcription factors, enhancers can enhance the transcription of a target gene.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

CB

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4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Title: Implications of Tyrosine Kinase Inhibitors Used Primarily for Non-Small Cell Lung Cancer on Various Bodily Systems Predicted Through Pathway Functions and Gene Expression.

Student Name(s): S. Adams

Abstract:

Afflicting many individuals with non-small cell lung carcinoma, epidermal growth factor receptor (EGFR) alterations are present in a relatively significant number of patients with the illness. EGFR has a large presence in cell-to-cell signalling and as a result is strongly connected to a myriad of systems in the human body, with a significant impact in organs with high EGFR expression. The protein itself can be linked to many other downstream pathways leading to a diverse set of effects. Most directly, EGFR takes an active part in mediating cell proliferation and mitigation. In cells with EGFR mutations, the overexpression of EGFR can lead to excess cell proliferation and formation of tumors. In response, drugs have been developed to inhibit EGFR function in an effort to staunch cancerous growth. This research takes a broad look into the side effects of both reversible and irreversible tyrosine kinase inhibitors (TKIs), including Erlotinib, Gefitinib, Osimertinib, and Afatinib amongst others, as used for the inhibition of EGFR. Utilizing databases including the Kyoto Encyclopedia of Genes and Genomes (KEGG), AmaZonia!, and PubMed, information was used to summarize and organize data concerning EGFR function to form predictions on cell activity and organ function. The findings suggest that processes involving restoration and maintenance are likely to be impaired, and a reduction in other bodily activities including inflammation and fibrosis can be seen among other effects as a result of EGFR inhibition.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   ME AT BI

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4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

CSEF Official Abstract and Certification

Fair Category

Project Number

258

LS

3075

Title: A Photonic Crystal-based, Non-Invasive, Color-Changing Sensor for Detection of Salivary SOD2, for Diagnosis of Hepatocellular Carcinoma

Student Name(s): H. Clausi

Abstract:

Hepatocellular carcinoma (HCC) is the most common type of liver cancer. Annually, over 800,000 people contract HCC and around 700,000 die, making HCC the third leading cause of worldwide cancer deaths despite being only the sixth most prevalent. Currently, HCC is diagnosed through blood tests, invasive liver biopsies, and costly imaging tests, such as CT and MRI, which all require trained personnel. My research is focused on developing an alternative diagnostic tool; a low-cost, non-invasive, easily readable sensor to measure superoxide dismutase 2 (SOD2) levels in saliva. To begin, a photonic crystal microchip with opal structure is created through the spin-coating of monodispersed latex spheres onto a PDMS glass substrate. This microchip is dipped in an aqueous prepolymer solution containing SOD2, then cleansed under 100W UV with acetic acid, sodium dodecyl sulfate solution, and deionized water. 10μL of SOD2 is then dropped onto the microchip and left to dry for 10 minutes. The PC microchip exhibits a change in intensity when exposed to SOD2. The ratio of 0.14 (clean SOD2 chip) to 0.34 (chip with SOD2) is measured through a UV-Vis spectrometer and SEM. The high sensitivity and color pay-off of the chip when introduced to a low concentration of SOD2, paired with free iPhone RGB analysis apps and simple 3D-printed light isolation cases, show promise for this diagnostic tool's usefulness in the point-of-care field. This non-invasive, easy-to-use, and inexpensive (~$15) clinical diagnostic tool for early detection of hepatocellular carcinoma can dramatically increase survival rates for HCC.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   BI EN ME

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4. Is this project a continuation? ☐ Yes   ☒ No

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☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count
228

Fair Category
LS

Project Number
3076

Title: Differences in Giving Up Densities of Sciurus Carolinensis in Urban vs Rural Environments

Student Name(s): N. Levinson

Abstract:

Humans are expanding their area of use at a rapid rate that is only increasing. There is little research on the effects of human developments on the Landscape of Fear (how much they fear predation) in foraging animals. The variation in giving-up densities of Sciurus Carolinensis in urban and rural environments will be tested. Rural environments should have a higher giving-up density than the urban counterparts. Trays were placed at 0, 10, 20, and 30 meters from a tree line into an open field. The trays were filled with sand and 500 grams of whole corn. The squirrels were allowed to forage from sunrise to sunset for four days at each site. A conditioning period of two days where no sand was added was used to allow the squirrels to become acclimated to trays and food. It was found that rural squirrels had a greater giving up density than urban squirrels. On average, the 30 m tray for the rural population had 486.25 g remaining while the urban population had 310 g remaining. The rural population showed a greater difference in giving up density in between trays. The findings in this experiment show that human developments are having an impact on the foraging behavior of animals. As humans continue to develop, minimizing the impact that our developments have on these behaviors should become a greater priority.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   AS EM EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Are Phones Bad for You?

Student Name(s): Z. Choudhry

Abstract:

In order to determine if cell phones released electromagnetic radiation and to also determine whether electromagnetic radiation negatively affects humans, we decided to measure the amount of electromagnetic radiation that was released by a cell phone in hertz, when being called, over the distances of 2 cm, 5 cm, and 15 cm away from a radio frequency (RF) meter. For each distance, we decided to run three trials and we also averaged the results of all three trials per distance. After this, we would compare this data to the amount of electromagnetic radiation that causes negative effects to the human body such as sleep disorders, concentration issues, cardiovascular disorders, and memory loss. After conducting this experiment, our team was able to conclude that phones do release electromagnetic radiation and that the amount of electromagnetic radiation that is released by phones does not cause any of the mentioned negative effects on humans.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) ME BE AT

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Title: Using Deep Learning to Efficiently Quantify the Impact of Road Salt Runoff on the Swim Performance of Wood Frog Tadpoles

Student Name(s): M. Zhang

Abstract:

In recent decades, roads have undergone a staggering expansion upward of 60 million km in length for the U.S. alone. These conduits of salt pollution permeate freshwater habitats, leading to rising extinction rates of 4% annually. Local wildlife like wood frogs, a widespread species vital to ecological diversity, have been severely impacted by salinization. Yet, there is relatively little known about tadpoles' reaction to de-icing compared to adults. Thus, this study focuses on how road salt exposure influences wood frog tadpole swim performance, pivotal to predator evasion. Due to restrictions, my supervisor exposed 11 groups of tadpoles to four salt concentrations up to 7,000 µS/cm and administered burst-swim trials. 650 videos overall were trimmed and analyzed using deep neural networks, a set of algorithms based on the brain capable of extremely efficient motion analysis, from the Python package DeepLabCut. Tadpole tails in 200 derived images of the training dataset were manually labeled and the network underwent 13,500 iterations to learn tail-tracking. The network then analyzed videos autonomously, providing tail coordinates for each frame. The R package trajr was used to analyze these coordinates for sinuosity, an angular measure of motion flexibility that better characterizes tail fluctuations and fitness. Results suggest that although swimming ability decreased as road salt first increased, a potentially adaptive natural safeguard was triggered by harsh conditions since the greatest sinuosity values occurred at the highest salt level. Consequently, this encourages novel conservation strategies, working in tandem with evolutionary processes, to mitigate contamination.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) EV BI CS

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☐ vertebrate animals　　☐ controlled substances

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
198

Fair Category
LS

Project Number
3079

Title: Investigating Interplay between Amyloid-β and Tau and its Contribution to Neuroinflammation in Alzheimer's Disease Progression

Student Name(s): A. Kabra

Abstract:

Alzheimer's Disease is classified as the most common neurodegenerative disease that triggers and furthers the onset of neuronal cell death as a consequence of hallmark pathological changes. Since there is yet no cure for dementias such as Alzheimer's Disease, there is a perpetual cognitive function and development decline in diseased patients. The hallmarks of Alzheimer's Disease include abnormal amyloid beta plaques, neurofibrillary tangles, and neuroinflammation. While these neuronal processes are interlinked, it is not entirely understood how they are related or regulate each other. I will focus on the relation of neuronal processes and Alzheimer's Disease pathology, more specifically the influence of amyloid beta peptide aggregation on the Tau protein, dysregulated inflammation, and defective degradation mechanisms. In this paper, I analyzed the interaction between amyloid beta and tau tangles and how this leads to proinflammatory patterns, which results in neuroinflammation observed in Alzheimer's Disease. In context, I observed evidence for induction and progression of MAPT and TREM2 through analysis of RNA-sequencing (RNA-seq) data. In examining and correlating the pathological hallmarks for Alzheimer's Disease, neuronal abnormalities and dysfunctions have been analyzed with the intent to uncover new potential therapeutic approaches for rescuing degenerative cell function and structure.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   CB ME MA

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☐ vertebrate animals   ☐ controlled substances

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3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

Word Count

253

Fair Category

LS

Project Number

3080

Title: A Natural Remedy to Decrease Asthma

Student Name(s): S. Akther

Abstract:

The original goal for this project was to find a way to minimize asthma attacks and symptoms. Food intake and asthma symptoms were looked into which concluded that there was some correlation between food intake and asthma. Turmeric specifically has shown in previous studies to reduce inflammation in the lungs. This lead to a turmeric tea experiment being created to measure participants' symptoms and asthma color zone before drinking turmeric tea and after drinking turmeric tea. The hypothesis of this study was if turmeric tea is drunk daily, then the subject will show a decrease in asthma symptoms. The independent variable was the addition of tea to a person's diet. The dependent variable was the self-reported asthma color zone and symptoms. The control variable was the first 2 weeks of the experiment. The experiment was done on 2-5 people with asthma diagnosed by a physician. During the experiment, participants filled out a survey every day during a 4-week process: tracking their symptoms without turmeric tea for 2-weeks and with turmeric tea for 2-weeks. The data showed participants experienced frequent coughing and shortness of breath during the first 2 weeks, however, these symptoms decreased during the weeks in which they were drinking the turmeric tea. This data supported the hypothesis that turmeric tea can help decrease asthma symptoms in people. Future studies can be done in larger groups of people to see how turmeric tea affects them and whether it can be used as a natural remedy to control asthma.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   ME

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4. Is this project a continuation? ☒ Yes ☐ No

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Impact of COVID-19 Pandemic on Swimming Athletic Performance

Student Name(s): E. Huang

Abstract:

It has already been shown that COVID-19 has had a big impact on student mental health and academic performance. The purpose of this study was to investigate whether COVID-19 impacts swimming athletic performance and whether it differs based on age groups, gender, and states. We hypothesized that there would be an increase in time for different swimming events from 2019-2020 to 2020-21,especially in females and younger children. Public available data was collected from 3 different states of Connecticut, South Dakota, and Maine. The top available times for 100 freestyle and 200 freestyle from the ending period of the short course season of 2019 to 2020 and 2020 to 2021 were collected for both male and female, ages 11-12 and 15-16. The time differences in each of the events for the 2020-2021 and 2019 -2020 seasons were then calculated and compared between the groups. We found that there was a large increase in time for both events ($p<0.01$). The increase was significantly greater in the 11-12 age group when compared to the 15-16 age group ($p<0.01$). There was no significant difference in the change between the gender groups. Among the three states, Maine had a noticeably larger increase than the other 2 states ($p<0.01$). This study suggests that COVID-19 had a great impact on swim performance, especially for younger swimmers. The effect it has on different states needs further investigation.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) MA ME

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Analyzing the Relationship Between Acceptance of Virtual Communication Mediums with Depression Proneness, FOMO, and Social Anxiety

Student Name(s): K. Lu

Abstract:

Since March of 2020, a substantial increase in average levels of fear-of-missing-out (FOMO), social anxiety, and depression proneness (all behavioral indicators of negative mental wellbeing) has been noted by psychologists. Recent studies have suggested that prolonged usage of virtual communication mediums (VCM) may be partially responsible. This study aims to assess the relationship strength between VCM usage and negative-valence psychological factors such as social anxiety, depression proneness, and FOMO. An online survey was distributed to a group of highschool and college student participants, containing questionnaire items from the Przybylski FOMO test, the Willoughby Social Anxiety Scale, and the Depression Proneness Inventory, measuring FOMO, SA, and DP, respectively. Participants then received a second survey on their estimated weekly virtual communications usage alongside a personality-sociability questionnaire from the 16PF. Participants were then disbanded and multivariable analysis was conducted on gathered data. The data collected currently suggests a strong positive relationship between VCM usage, social anxiety, FOMO, and depression proneness. Multivariable analysis suggests that all three negative behavioral indicators are additionally co-related in strength/direction. Regression analysis with known confounding variables such as personality valences and pre-pandemic VCM usage did not significantly alter the strength of observed relationships. Data variability is currently high due to participant pool limitations, with further data collection ongoing. Overall, the study thus far affirms the conjectural hypotheses of previous studies: that excessive usage of VCMS is indeed related to negative behavioral indicators. However, a precise causal relationship remains uncertain. so controlled lab-based continuations are planned for the future.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) BE ME

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4. Is this project a continuation? ☐ Yes ☒ No

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Non-Canonical Base Pairing in Self-Assembling DNA Crystals

Student Name(s): W. Bernfeld, N. N/A, N. N/A

Abstract:

The scientific community has long recognized the four naturally-occurring nucleobases as the universal genetic language. However, this four-base model has recently been turned on its head with the development of "hachimoji" nucleic acids, which use up to eight bases. Four new synthetic components have been incorporated into a variety of sequences. These sequences, in turn, have been used to encode basic information and to construct a wide variety of crystals and nanocages. In this investigation, we furthered our understanding of hachimoji DNA by using the Python-based Hierarchical ENvironment for Integrated Xtallography (PHENIX), the Crystallographic Object-Oriented Toolkit (COOT), and ChimeraX to simulate a base pair between cytosine and 5-methyl isocytosine. This virtual base pair is situated at the center of a DNA strand derived from a previously-designed sequence, developed roughly 11 years prior. This pairing is considered degenerate because its components do not normally form hydrogen bonds. However, it shows coherence within the digitized sequence, and therefore suggests that the pair can exist in the real world. Should future research reveal further evidence of its existence, this development has tremendous implications for the biochemical sciences, e.g., molecular computing, genetics, and immunology. Because the new base pair may be capable of encoding peptides using non-proteinogenic amino acids, our findings may be used for the development of new, unique proteins. These molecules, encoded using hachimoji nucleic acids containing the cytosine-5-methyl-isocytosine base pair, may prove effective in the treatment of genetic and/or metabolic illnesses such as diabetes, anemia, and cancer.

**Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)** CB EN BI

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4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☒ Yes ☐ No

CSEF Official Abstract and Certification

Title: The Role of ICAM-1 in Facilitating Leukocyte Migration Across the Blood-Brain Barrier in the Progression of Multiple Sclerosis

Student Name(s): P. Kurup

Abstract:

Multiple Sclerosis is a chronic autoimmune disorder that affects nearly one million adults in the United States. In patients living with MS, leukocytes are able to migrate into the central nervous system through the blood-brain barrier (BBB), causing damage to neuron connections. As the disease progresses, the BBB becomes weaker and thus ineffective in its function as a selective semi-permeable border between the body and the central nervous system. Recent studies suggest that cell-adhesion molecules may facilitate the migration of leukocytes through the barrier; further research is needed to identify the mechanisms by which this occurs. Accordingly, this research investigates the role that intracellular adhesion molecule 1 (ICAM-1 or CD54) plays in damaging the blood-brain barrier to allow leukocytes to enter the brain. An in-vitro model was developed with cultured brain microvascular endothelial cells seeded atop an extra-cellular matrix gel (the BBB model) within a Mimetas 3-Lane OrganoPlate. White blood cells isolated from whole blood and stained with ICAM-1 were added to a cell culture media of 10% FBS in RPMI 1640 (with phenol red). Leukocytes with and without ICAM-1 were added to the 3-Lane OrganoPlate, and profusion through the BBB was studied. After only one day, significant BBB damage and subsequent leukocyte profusion was observed in 70% of trials where ICAM-1 was attached, compared to trials in which ICAM-1 was not present. These findings provide compelling evidence that ICAM-1 plays a significant role in damaging the BBB and facilitating leukocyte migration into the central nervous system.

**Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)** CB ME

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Examining the energy efficiency of variations of Synechocystis nigrescens bioinks in biophotovoltaic cells

Student Name(s): Y. Jang

Abstract:

Biophotovoltaic (BPV) cells harness energy through the electron transfer of microbes leading to wide scientific interest in their potential applications as renewable energy. Several studies showed sustained energy output using the cyanobacteria species Synechocystis through experimental methods such as 2D printing cells onto copy paper and combining two different microbe species for longevous output in a traditional fluid chamber design. This project examined the effects on energy output of cyanobacteria Synechocystis nigrescens when manipulating three elements of the BPV system: 1) carbon cathode types (carbon cloth vs. carbon paper), 2) paper types (copy paper vs. filter paper), and 3) effects of plasmid mixed bacteria (transformed vs. untransformed). The paper-based BPV system of this project consisted of carbon cathode and anode components with anode containing Synechocystis nigrescens "bioink" on paper and hydrogel as an electron flow material. Through different manipulations on the BPV system, the potential opportunities to maximize power for this alternative energy were observed. Measurements were obtained from both a self-fabricated JUAMI potentiostat and a multimeter. Findings indicated that 1) carbon cloth, 2) filter paper, and 3) untransformed bacteria tests produced the greatest power densities relative to other tests. One avenue of interest for microbial BPV cell systems is using paper-based BPV cells as eco-friendly "disposable energy". This explains the use of papers (i.e., carbon, copy, filter) as the main tests of variation in this project's experimentation. This light and compact battery alternative opens doors to possible advancements in daily medical aids, outdoor survival, and space technology.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

EN MI EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects ☐ potentially hazardous biological agents

☐ vertebrate animals ☒ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

142

Fair Category

LS

Project Number

3087

Title: The Effects of Negative Thermal Stress on the Germination of Invasive and Native Plant Seeds in Connecticut

Student Name(s): E. Brown

Abstract:

This study tested the effects of negative thermal stress on eight seed types, four of which were native to Connecticut and four of which were invasive to Connecticut. Each seed species collection was split in half, with half of each species experiencing negative thermal stress. All of the seeds were then germinated for three weeks and the number of seeds that germinated within each sample were counted. The difference in the number of germinated seeds from each species exposed to negative thermal stress was compared to the percentage of germinated seeds of the same species that were not exposed to negative thermal stress. This showed that the seed species out of the types used in this experiment that best survived negative thermal were native to Connecticut, thus showing that plants native to Connecticut survive better thermal stress than plants invasive to Connecticut.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

PS EV EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
254

Fair Category
LS

Project Number
3088

Title: Synergistic effects of Feraheme® and several ROS-inducing drugs

Student Name(s): W. Nomani

Abstract:

The five-year survival rate of pancreatic cancer is approximately 3%, making it an unmistakably fatal condition. Since most pancreatic cancers are diagnosed at metastatic stages, they are a challenge to treat. Traditional chemotherapies are associated with many risk factors, such as a variety of adverse effects on healthy cells. However, nanotechnologies (particles with sizes of less than 100 nm) present a promising way to deliver chemotherapeutic agents to mitigate issues with free chemotherapy drugs, such as an increased chance of infection, easy bleeding or bruising, and shortness of breath. One current treatment of pancreatic cancer includes the combination therapy of Gemcitabine and Paclitaxel. We also explored the possibility of Feraheme® acting as a reactive oxygen species (ROS) generator. Since active iron can generate ROS in cells leading to cell damage, Feraheme® should work similarly. In this study, we non-covalently loaded several ROS-inducing drugs onto iron-oxide nanoparticles (Feraheme®) for the treatment of pancreatic cancer cell lines and measured cancer cell viability compared to untreated cells. We found that cells treated with both Feraheme® and drug had a synergistic effect that increased lipid peroxidation and decreased viability; thus, they showed promise as a targeted cytotoxic combination. We are also currently functionalizing Feraheme® with an amine-based coating and an O-PEG coating to determine which particle has better cell entry. Regardless, nanoparticle therapies are still more desirable than traditional chemotherapies for fatal cancers like pancreatic cancer because they can effectively target and kill cancer cells with minimal damage to healthy neighboring cells.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) | BI CB

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☒ potentially hazardous biological agents
☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☒ Yes ☐ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Determining the Efficacy of Zingiber Officinale to Promote the Bioremediation of Bioplastics through Amylase Hydrolysis

Student Name(s): S. Matregrano

Abstract:

As the expansion of the bioplastics industry continues to grow there is a new stress to mitigate the long and short-term effects of starch-based bioplastics on environmental parameters. This research proposes that Zingiber Officinale (ginger) can be used to promote amylase hydrolysis of starches in Crassostrea virginica (Eastern Oyster), the model filter feeding organism, allowing for less excess starch to remain in the marine environment. The purpose of this experiment is to determine the water quality mitigation requirements and the efficacy of the oyster ginger/amylase systemic bioremediation process. Multiple trials were conducted to evaluate water quality parameters over a twenty-four-hour period with the addition of bioplastics to saltwater. Starch absorbances of tanks with oysters and different concentrations of ginger were compared to measure the starch concentration over time. All research was independently designed and executed unless otherwise noted. Hardness, salinity, and temperature were not affected while the turbidity, dissolved oxygen, and pH data indicated that there was a statistically significant change over time due to bioplastics. Data concluded; oysters treated in a .1M ginger solution bioremediated 230% more starch than the untreated oysters, oysters treated in a .055M concentration of ginger bioremediated 317% more starch in 5 hours compared to untreated oysters. The starch concentration decreased 13% faster in the .055M solution compared to the .1M solution. Future applications include a secondary ginger treatment of oyster beds for bioremediation of microplastics in addition to the supplemental ginger in the starch matrix of biodegradable plastics prior to dehydration.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) EM BI EN

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: The Anti-viral Entry and Anti-Inflammatory Effects of Camostat Mesylate and Ginkgolide A on SARS-CoV-2 Spike Protein Treated Lung Epithelial Cells

Student Name(s): A. Sun

Abstract:

The novel coronavirus disease 2019 (COVID-19) is the cause behind the current global pandemic, capable of inducing pneumonia-like symptoms and organ failure. Ginkgolide A and camostat mesylate are two chemicals that show promise in anti-inflammation and anti-viral cellular entry, respectively. Ginkgolide A (GA)is a compound commonly found in the leaves of the Ginkgo biloba tree, and has been researched as a potential anti-inflammatory drug. Camostat mesylate (CM) is a clinically proven serine protease inhibitor, which may be key for reducing SARS-CoV-2 entry induced by the serine protease TACE. MTT cell viability assay, LDH cytotoxic assay, and ELISA assay were used to determine if GA and CM can mitigate viral spike protein damage toward cells. These methods of data analysis revealed that the presence of spike proteins significantly diminished the viability of the lung epithelial cells, an effect which GA and CM were able to reverse dose-dependently. In addition, the considerable increase in inflammatory cytokines in the cells induced by treatment with spike proteins was ameliorated by GA and CM, lowering the concentrations of cytokines IL-6, TNF-a, and TGF-b down to near-untreated levels. The use of both target chemicals has been shown to suppress immune response, suggesting their potential roles in the treatment for the inflammatory symptoms of COVID-19. Furthermore, results confirm the presence of anti-inflammatory and anti-cell death properties of CM and GA, as they increased viability and reduced cytokine production, ultimately suggesting that the GA and CM may be effective components for COVID-19 inflammation treatment.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) ME CB

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Active Aeration of Hydroponic Systems.

Student Name(s): A. McLaughlin

Abstract:

Objective :Hydroponics is a novel way of growing food. Hydroponics grows plants with roots suspended in water. Growing in buckets of water allows precise control of the growing medium giving the farm a way to reduce waste of water and nutrients. Aquaponic technology is a growing field of research because of its increasing use in the agricultural sector. Because oxygen content influences rooting depth active aeration was tested as a way to increase growth.

Methods: Two groups of arugula were grown in containers of water, pearlite and fertilizer. The experimental group was bubbled 24/7. The control group had stagnant water. 6 week old plants were removed and measured for mass and length..

Results: The average length of the experimental group was 5.5 cm. The average length of the control group was 3.3 cm. Mass was never taken because every arugula combined did not register on my scale. The survival rate of the experimental and control was 38% and 16% respectively.

Conclusion: This study cannot draw strong conclusions. Many plants never germinated. Molds and algae contaminated both groups. Nevertheless, the experimental group had algae, which probably comprised a majority of the biomass and survived better against the onslaught of diseases. Perhaps that means aerated water is better for plant life.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   PS AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count
211

Fair Category
LS

Project Number
3092

Title: Improving the physical and mental health of astronauts with plants.

Student Name(s): S. Michael

Abstract:

During spaceflight, astronauts have a very limited diet that is repeated every 8 days. Due to the lack of variety in their food options, they can suffer from diet fatigue. The loss of muscle and bone mass paired with a physical decline will limit their ability to complete needed tasks. The goal for this project was to determine if adding plants into their diet,increasing the variety and freshness of the food, could reduce the risk of diet fatigue as well as increase the mental health of astronauts. I concluded that iIn order for astronauts to get regular nutrients, they would have to plant a variety of different plants, some of which may include radish, lettuce, spinach, broccoli and carrots. Astronauts would have to have enough time to grow these in space and would have to bring enough prepackaged food to last until all the plants with the right nutrients are fully developed. Research also determined that caring for plants and adding them into their diet would increase moodsThis information can help with preparing for future space flight by reducing the amount of storage space taken up in the spacecraft. If prepackaged food isn't needed for an entire mission, the extra space could be taken up by more supplies or experiments.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   PS ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
237

Fair Category
LS

Project Number
3094

Title: Heating Oceans And Their Threats To Marine Life

Student Name(s): S. Young

Abstract:

My research project, Heating Oceans And Their Threats To Marine Life, is an attempt to bring more attention to the fluctuating temperature in Earth's oceans, and how they affect all of the marine life around them. I have been working on developing a plan for everyone to easily reduce their carbon footprint in order to preserve our oceans and save marine ecosystems at risk. In order to come up with this plan I researched the fluctuation in temperature to determine how it is affecting different species of plants and animal life.

I started by researching the effects of temperature change on wildlife living in the oceans and then researched the causes of coral bleaching, loss of breeding grounds, and animal endangerment. The main causes of these issues that were found included ocean acidification and carbon waste. I used this research to conclude how reducing our carbon footprint would have a substantial impact on returning our oceans to their healthier state. After the research was found, I created a list of things that the general public could easily follow to decrease their carbon footprints. The goal is to increase the ability to inform the public that their choices can truly can make an impact. On top of the guides that were created from my research, I also added websites and foundations that people can follow to increase their understanding of their impacts and climate change in our oceans.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   EM EA AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count
251

Fair Category
LS

Project Number
3095

Title: How have vaccines developed through different pandemics and how do they compare to the development of the COVID-19 vaccine.

Student Name(s): S. Gudlavalleti

Abstract:

Studies on the progression of vaccine development show that vaccine development has changed over the last hundred years. The purpose of this research is to understand how vaccines work and how the development process has changed through different pandemics and how they compare to the development of the COVID-19 vaccine. Before the research process began, the hypothesis was that due to the advanced technology that we have today, the COVID-19 vaccine progression will be much faster in comparison to the other pandemics vaccines. In order to come to my conclusions, I used multiple questions and multiple sources to make sure the data I collected was thorough and accurate. Through this process, I was able to conclude that my hypothesis was correct. The Covid-19 vaccine was the fastest that any vaccine had previously been developed, from viral sampling to approval. It became clear how this pandemic changed the future of vaccine development since it shows how fast development can proceed and how it does not compromise on the safety of the virus. But through my research I was able to see the differences between this vaccine and other vaccine development. With the Covid-19 pandemic the funding and testing the vaccines were abundant. Countries poured funding into pharma companies. Normally the slowest part of vaccine development which is the testing them was sped up. The COVID-19 vaccines went through the same trials, but with the funding poured into the process, it was possible for companies to take risks.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) ME BI CB

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2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

254

Fair Category

LS

Project Number

3096

Title: Finding a New Use for Essential Oils: An Examination of their Preservative, Nutritional, and Economic Benefits.

Student Name(s): Z. Koskinas

Abstract:

Since 4500 BC Essential Oils have been remedies ranging from topical blends to ingested relief. Essential oils offer low toxicity, natural, and safer alternative approaches to treat disease as compared to conventional medications. The effect of these volatile hydrophobic oils on food as an additive, particularly fast-food Russet potato fries, was examined. The goal of this study is to identify oils that have a greater nutritional, economic, and preservational impact as compared to the techniques used by fast-food chains. Five Essential Oils were tested to reveal which have the greatest antibacterial properties against brown rot (Ralstonia solanacearum) in the potatoes, which was identified by observation and Optical Microscopy. This was conducted by a blanching process of a uniform sized potato. Three oils with the highest antibacterial properties were tested against three of the most common large-scale food preservation techniques (Dextrose, Sodium Acid Pyrophosphate, and UV lighting.) After each independent variable was applied to the potatoes the nutritional value was evaluated by bomb calorimetry, the presence of brown rot as determined above, and a cost analysis performed. Each of these oils was in the presence of a 15% concentration per 28 grams of water. The three oils are Lemongrass, Lavender, and Oregano. Further, these three oils will be tested in comparison to Dextrose, UV lighting, and Sodium Acid Pyrophosphate. Over the last 4 weeks Dextrose and Sodium acid Pyrophosphate have had the highest antibacterial properties. The use of the oils promises a safer, effective, and more cost-efficient way of food preservation.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

CH PS ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Title: Testing Handmade, Pit Fired Clay Water Filters to Produce Clean Water for Developing Nations

Student Name(s): H. Lawlor

Abstract:

The purpose of this research project is to test a handmade, pit fired clay filter in order to clean water for developing countries. While there has been research done in this area, this project is focusing on using a different pot design to see how it will affect the cleaning process of the water. Within this experiment, there are two designs being tested to see which pot is more effective and efficient. The process of pit firing will be used because it is an accessible technology to developing nations. Once the pots have been pit fired, water from a local pond will be filtered, then the turbidity will be tested at a nearby city water department laboratory. A t-test will be used to determine the significance of the sample results.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   EM EV EA

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☐ vertebrate animals   ☐ controlled substances

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3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☒ Yes   ☐ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count
250

Fair Category
LS

Project Number
3099

Title: Does prolonged usage of masks damage our skin by increasing Demodex folliculorm and brevis mites, and the bacterial growth resulting in acne on our face?

Student Name(s): A. Davis

Abstract:

With our current society living in the coronavirus pandemic, people are being afflicted to skin irritations from a prolonged usage of wearing face masks. The reason behind these reactions is due to an increase of bacterial growth causing acne production. The purpose for this study is to better understand how wearing a face mask throughout the week can cause skin damage.

After subjecting participants to wearing cloth cotton face masks, 86% Polyester, 14% Spandex masks, and Single-Use Protective Mask (Non- medical paper), Size 175*95MM (15%) observations showed numerous reactions to the skin of the participants. The participants were instructed to wear a mask (washed daily) throughout the 2 week span and report back for data collection daily. From 5-22 hours of usage, participants (14-39 years old) showed an increase of acne. After the 2 weeks, participants were swabbed around their face and the inside of their facemask. The samples went on designated petri dishes (agar dishes), and the growth of bacterial colonies were regulated. An increase of Streptococcus (gram positive bacteria), known for skin irritation and respiratory infection was present on the face masks.

This process of examining the participants skin and bacterial growth provides evidence that bacterial increase is present and negatively affecting the users skin from long usage. These results are leading me to further the examination of this current phenomenon by calculating the number of colonies, isolating some bacteria for classification, and exposing the participants to tea tree oil in hopes to reduce skin irritation.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) MI ME CB

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No
4. Is this project a continuation? ☐ Yes   ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Title: A Cross-Sectional Identification of Irrationality and Risk Preference Variation Using Proposed Risk Scenarios

Student Name(s): A. Kleshchelski

Abstract:

Marketing and related focus initiatives continue to investigate the evolving tendencies within heterogeneous social groups. Identification and understanding of risk-preferences within a specific age group (e.g., Millennials vs. Baby Boomers) would lead to the development of targeted and pointed efforts in development of products and services, and better communication amongst the barrage of social media contacts. In the research that follows, one's willingness to take risks (risk preference) was investigated, as a function of many social groupings. To elicit risk preference and reveal irrational biases, a survey containing two types of hypothetical risk scenarios was created. Respondents first answered ten social-grouping questions, and afterward, scenarios were presented to measure risk-aversion or risk-seeking tendencies. In part-2, scenarios were presented to reveal rationality in responses, with risk-taking traps within single-scenario choices. Disseminated via Amazon Mechanical Turk and Google Forms, 400 diverse participants responded to the survey, and their responses later analyzed. For generational cohorts, Baby Boomers were the most risk-seeking, followed by Gen-X, Gen-Z, and Millennials. Millennials were the most irrational, with all generational tendencies likely attributed to fiscal environments during the group's childhood years. Positive correlations were found for risk-aversion with wealth and number of siblings. Advanced levels of the first grouping likely provide confidence/security in decision making; those with more siblings tend to be more protective of their place in society, brought about by a historic struggle for attention and consideration. Hispanics were the most risk-seeking, and Asians were the most risk-averse. Native-Americans were the most contradictory within their responses.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) BE ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☒ human subjects   ☐ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
246

Fair Category
LS

Project Number
3101

Title: Applications of AI in PET imaging of brain tumors

Student Name(s): J. Shatalov

Abstract:

The purpose of the project is to evaluate the different methods for diagnosis and management of brain tumors. Specifically, the application of machine learning and AI in interpreting PET scans in gliomas. A total of four databases were searched: Ovid Embase, Ovid MEDLINE, Cochrane trials (CENTRAL), and Web of Science-Core Collection. The search strategy used both keywords and controlled vocabulary combining the terms for: artificial intelligence, machine learning, deep learning, radiomics, magnetic resonance imaging, glioma, as well as related terms. The study was approved by the IRB. An initial 11727 publications were imported for screening. After review by 2 researchers, 1135 studies passed on to full-text review and 715 were included. Twelve of these publications focused specifically on PET. The imaging features from PET, MRI, or PET/MRI were extracted from a variety of gliomas and information correlated to histopathologic data. All publications utilized single-center databases. Apart from two papers, all used supervised machine learning algorithms. PyRadiomics was utilized in 3/12 papers, and additional features included TBRmax, TBRmean, SUV, TTP, in vivo, ex vivo, patient features, and more. Additionally, the studies involved in a variety of applications of PET, including prediction of treatment response, survival, molecular subtypes, tumor grade, and segmentation. Data extraction yielded results indicating that machine learning in PET was successful in accurately predicting such characteristics. After performing the systematic review, FDG and FET PET were found to play a role in tumor grading and were complementary to MRI based methods.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   CB ME MI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- ☐ human subjects
- ☐ vertebrate animals
- ☐ potentially hazardous biological agents
- ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☒ Yes ☐ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count
199

CSEF Official Abstract and Certification

Fair Category
LS

Project Number
3102

Title: Forest Fires Fuel Droughts

Student Name(s): E. Kirck

Abstract:

Climate change has an impact on many aspects of life and the environment that we live in. In recent years, the frequency of forest fires has been increasing worldwide and so has the land area affected by drought. This project aimed to test the interdependence between forest fires and droughts. If the amount of land burned by forest fires increases, then the intensity of droughts will increase because forest fires increase levels of carbon dioxide in the atmosphere which in turn would raise average temperatures thereby increasing drought occurrence. In order to test this idea, data was obtained from multiple sources (California and Australia), and analyzed using scatter-plot graphs. Data analysis included graphs to compare forest fires to carbon dioxide emissions, as well as average precipitation levels. This was followed by a combinatorial analysis of forest fire acreage burned and average precipitation. The analysis reveals a direct correlation between forest fires and droughts. It was inferred that as forest fires burned more land, the average precipitation decreased, thereby facilitating drought occurrence. The data reminds us of the long-lasting effects of climate change and the importance of maintaining our "living" planet, one that can sustain human life for years to come.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   EV EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Title: Analysis of the identity of the Genotype 4 Eurasian Avian-like H1N1 Virus and an Epidemiological Study of Possible Human Transmission Leading to a Pandemic

Student Name(s): A. Thite

Abstract:

The 2019 Coronavirus Pandemic (COVID-19) cautioned towards preventing future pandemics. Genotype 4 (G4) Eurasian Avian-like (EA) H1N1 Swine Influenza Virus (SIV) is another virus that surfaced in China. Although no human-to-human transmission has been detected, understanding the extent of the virus can prevent another widespread crisis. G4 EA H1N1 virus bears the 2009 H1N1 Swine Flu pandemic, but after evolution, EA H1N1 swine influenza viruses were reassorted with other influenza viruses. Phylogenetic analysis from two Chinese human cases confirmed genetic reassortants: the hemagglutinin, neuraminidase, and matrix genes related to genes in EA H1N1 SIVs, the polybasic 1 and 2, polymerase acidic, and the nucleoprotein genes originated from influenza H1N1 2009 pandemic virus, and the nonstructural protein gene derived from classical H1N1 SIVs. In vivo studies, the substitution of D701N and R251K in the polybasic 2 protein enhanced the viral replication and pathogenicity of EA H1N1 SIVs. Sequence analysis in pigs showed that EA H1N1 is the predominant subtype virus in Chinese pig populations. Mean virus isolation rates from diseased pigs increased by almost 7% from 2011 to 2018, indicating that EA H1N1 SIVs are an issue in farms. Transmission experiments on ferrets determined that G4 EA H1N1 SIVs were transferred through direct contact and respiratory droplets. Ferrets inoculated with EA H1N1 SIVs experienced weight loss of up to 21%. The G4 EA H1N1 virus is rapidly transmitting between pigs and abattoir workers, and because of its highly replicable nature, it can become an extreme threat to humans if not monitored.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   ME CB

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects ☐ potentially hazardous biological agents
☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count

207

Fair Category

LS

Project Number

3104

Title: Designing a Blood Alcohol Tracker through Transdermal Alcohol Content to More Accuratley Test BAC

Student Name(s): W. Klein

Abstract:

The purpose of this project was to build a more accurate Blood Alcohol Content (BAC) testing system using Transdermal Alcohol Content (TAC). Upon drinking alcoholic beverages, ethyl alcohol is metabolized and is eventually secreted from the sweat glands. The level of alcohol embedded in the sweat is known as TAC. Today, modern breathalyzers can be an unreliable reflection of one's BAC. For example, unmetabolized alcohol in your stomach and oral cavity can lead to a higher BAC reading, while actions such as exercising, holding your breath, or hyperventilating can reduce a BAC reading. The transdermal device was created to more accurately measure BAC. Using a pilocarpine hydrogel to stimulate neural pathways in the sweat pores, secretions were collected using a 3-D printed wrist clamp and sickle shaped sweat collection device with an attached syringe. Collected liquid was run through a filter containing an alcohol oxidase hydrogel to separate hydrogen peroxide produced by the ethyl alcohol embedded in the sweat. Finally, a combination of a Bleach reagent #1, Maligdate reagent, and Via Sulfate reagent were used to measure the ppm of hydrogen peroxide in a sample. Data indicates that the created device and reagents can accurately measure levels of hydrogen peroxide, therefore producing an accurate BAC reading.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

EN AT BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: The Effects of Vitamin B9 on the Health and Lifespan of Tenebrionidae (Darkling Beetle)

Student Name(s): F. Scheggia

Abstract:

Vitamin B9 is essential for optimal brain and nerve function, however, it has not been connected to an increased lifespan. This project's purpose is to investigate whether vitamin B9 can extend lifespan in Darkling Beetles (Tenebrionidae). It is hypothesized that their lifespan will increase with the consumption of vitamin B9-rich foods. Thirty Darkling Beetles were divided into groups of eight and placed in three containers. The first container held the Darkling Beetles' normal diet, the second container contained vitamin B9 supplements and their normal diet, and the third container contained vitamin B9 foods and their normal diet. The number of living beetles at the end of each trial was counted. Beetles were also observed for any changes in movement and growth. At the end of the first trial, the B9 foods group had the largest number of living beetles (n=4), followed by the B9 supplementation group (n=3), and the control diet group (n=2). In Trial 2, the B9 supplement group and control group had the largest number of living beetles (n=3). The Control group had the highest number of living beetles at the end of trial 3 (n=6). However, there were more Darkling Beetles alive in the B9 foods group (n=5) than in the supplement (n=4). In conclusion, the results show that the Darkling Beetles benefited from the addition of B9 in their diet. Future research should focus on testing other organisms and other parameters of health in addition to lifespan and movement.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) AS ME BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects ☐ potentially hazardous biological agents
☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☒ Yes ☐ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
256

Fair Category
LS

Project Number
3106

Title: The Effect of Organic Duckweed versus Chemical Fertilizer on the Growth of Lactuca sativa and Ortho-Phosphate Runoff

Student Name(s): M. Liu

Abstract:

Chemical fertilizers used to enrich soils contribute to nutrient pollution through runoff. By determining if chemical or organic fertilizer contributes more to ortho-phosphate pollution and its effectiveness on plant growth, we can better manage ortho-phosphate pollution. I hypothesized that organic fertilizer, made from duckweed, will release less ortho-phosphate in runoff and be as effective at promoting growth compared to chemical fertilizers. The independent variable will be the type of fertilizer organic or chemical (Humboldt Nutrients 0 -10-0)] applied to the lettuce (Lactuca sativa). The dependent variables will be the ortho-phosphate amount present in the runoff and lettuce growth. Each experimental group consisted of 10 circular containers filled with 500 g of soil treated with 5 mLs of Humboldt 0-10-0 or the organic fertilizer once every week and 4 lettuce sprouts. They were grown indoors and watered 40 ml twice a week. When given fertilizer and water, they were set aside for 6 hours before the plants were watered and another container was placed under it to catch runoff for 5 mins. The Bartvation ortho-phosphate test strips were used to determine the ortho-phosphate concentration in the runoff and height was measured using a ruler. Data trends thus far show that organic fertilizer may not be as effective compared to chemical fertilizer for enhancing plant growth, but are still capable of promoting growth. By determining which type of fertilizer is better at promoting plant growth and how much ortho-phosphate they release, we can better protect our aquatic environments by redistributing recycled phosphate.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)
EM EV PS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects ☐ potentially hazardous biological agents
☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☒ Yes ☐ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count

275

Fair Category

LS

Project Number

3107

Title: Inhibition of COVID-19 Respiratory Complications via a R-954 Peptide Bradykinin 1 Receptor Antagonist

Student Name(s): E. Moore

Abstract:

Covid-19's effect on individuals varies from mild symptoms, to hospitalization and death for the elderly and those with pre-existing conditions. While initially thought to cause fever and inflammation via a cytokine storm, recent studies by Roche provides strong evidence that Covid-19 complications are instead due to a bradykinin (BK) storm. Once the virus has entered the host cell via the transmembrane protein angiotensin-converting-enzyme-2 (ACE2), the BK-regulating activity of ACE2 is disrupted, causing sudden increase in extracellular BK, and its metabolite des-Arg9-bradykinin (DABK), for the infected and neighboring cells. Heightened DABK is trafficked through the Bradykinin-1-receptors (B1R), causing leaky blood vessels, inflammation, and respiratory distress. Discovery of a B1R antagonist that can block this DABK passage could prevent acute respiratory distress syndrome of Covid-19, decreasing the threat of the disease. Herein, the R-954 B1R antagonist was investigated in-vitro for such use. A bradykinin storm was simulated as 2.5x the normal level of plasma (~3.5ng/ml), with 36ng/ml R-954 added in two configurations; simultaneously with DABK, and prior to DABK. For the first, competition of DABK and R-954 for B1R produced a 2.8x increase in extracellular DABK in 15min, and 3.7x in 30min, highlighting the peptide's ability to block DABK-B1R trafficking. Pre-addition of R-954 enhances binding to B1R before the addition of DABK upregulates extracellular DABK to 3.9x (15min) and 5.2x (30min). The combined results of this model provide compelling evidence for R-954's efficacy to block the inflammatory effects from DABK-B1R migration, to inhibit acute respiratory distress of Covid-19 and related diseases.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

ME CB EN

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☒ human subjects ☐ potentially hazardous biological agents

☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
191

Fair Category
LS

Project Number
3108

Title: Virtually Screen Drug Candidates to Target SARS-CoV-2

Student Name(s): L. Audie

Abstract:

SARS-CoV-2 is a virus that targets lung cells which could cause severe flu-like symptoms. It is an acronym for severe acute respiratory syndrome- coronavirus-2 (COVID-19). As of right now there are simply no cures for this potentially fatal disease. The goal of this experiment was to use the computational drug software YASARA, to virtually screen a database of natural, polyphenol molecules that would prevent the spike protein RBD from binding with the ACE-2 receptor. Particularly, Polyphenol Flavanones and Isoflavanoids were used because they were the most bioavailable and orally bioavailable of the Polyphenols. In order to accomplish this experiment, the contact residues 500, 501, and 502 were identified to use as a target for virtual screening. The top ten polyphenol molecules with the highest predicted binding affinities were selected to be docked in order to produce more accurate results. It was concluded that Naringin 6'- Malonate, Naringin, and Neoeriocitrin were the best drug candidates because they met a series of criteria: they had the highest binding affinities, they were in contact with resides 501, 502, or 503, and they formed at least one hydrogen bond.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

BI CB CS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents
☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
250

Fair Category
LS

Project Number
3109

Title: The Effect of Genotype of DOT1L On Cell Division

Student Name(s): S. Kadimi

Abstract:

DOT1L is a gene linked to active gene expression, but its mechanisms in cell division remain unknown. The purpose of the project was to determine what effect the genotype of DOT1L cells has on cell division. The independent variable was the genotype of DOT1L (wild type vs. mutant). Wild type cells are cells with DOT1L and mutant cells are cells without DOT1L. The dependent variable was the fraction of abnormal cells. It was hypothesized that DOT1L is involved in controlling cell division via expression of pericentromeric repeat sequences. The mentor acquired a series of microscopy images for DOT1L wild type cells and knockout cells. The student examined these images and classified each dividing cell into 'normal' or 'abnormal' appearance. The student then quantitated how many cells were normal vs. abnormal in wild type compared to knockout cells. The student tested if there was a statistically significant difference in the fractions of cells with abnormal mitoses using a Fisher's Exact Test. The data was also separated based on specific types of abnormalities: chromosome breaks, chromosome fusions, and premature centromere separation. Similar statistical analyses were run on these groups. Results demonstrate that the hypothesis was supported with more normal chromosomes in DOT1L wild type than in DOT1L knockout, suggesting that DOT1L is necessary for accurate cell division. This project will provide new insights into the molecular function of DOT1L. Better understanding how DOT1L functions will help design better drugs targeting DOT1L and also predict which patients will respond best to DOT1L inhibition.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)
CB

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents
☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

Word Count

265

CSEF Official Abstract and Certification

Fair Category

LS

Project Number

3111

Title: Prolonged, Smart Treatment of Multi-Drug Resistant Bacteria of Chronic Wounds via an EGCG-AgNP HydroMed Dressing

Student Name(s): Y. Sakai

Abstract:

In the US alone, 6.5 million people are affected by chronic wounds each year, and the burden on the healthcare system is $25 billion annually. Chronic wounds are of particular health risk to those with immunocompromising conditions, where 90% become multi-drug resistant due to subsequent biofilm formation. Current methods to prevent wound biofilm formation are limited in effectiveness, given the prolonged protection times needed, and the ever-changing nature of a wound. Accordingly, this research has developed a prolonged, smart dressing, where silver nanoparticles (AgNP) and epigallocatechin gallate (EGCG) were embedded into a HydroMed (Hm) hydrophilic polymer (at a 1:1:40 mass ratio) via ethanol dissolution. In an aqueous simulation of a constant-exuding wound, embedded AgNPs and EGCG were shown to consistently release from the Hm dressing for at least 24 hours. While each dressing component exhibited antibacterial properties on a simulated, already-infected wound for 24 hours (Hm: 31%, Hm-AgNP: 61%, and Hm-EGCG: 55% inhibition of H157-O7 E. coli), AgNP and EGCG acted synergistically in the smart dressing to inhibit ~70%. To simulate application of the smart dressing onto a freshly-cut wound, and demonstrate its "smart" properties (the dressing shrinks/dries upon wound closure, and reswells/re-releases antibacterials upon accidental wound reopening), 400mg dressing was placed into a freshly-inoculated E. coli culture. After 4 hours of simulated wound drainage, and 74% E. coli inhibition, the dressing was removed, dried, and reapplied to a newly-opened wound simulation. With reswelling, the AgNP-EGCG-Hm smart dressing was found to inhibit 78% E. coli for an additional 4 hours.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   EN ME AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count
251

Fair Category
LS

Project Number
3112

Title: Optimal Light Conditions for the Growth of Biofuel Algae

Student Name(s): I. Edelstein

Abstract:

Many universities and research institutes, such as the University of Texas Biofuel Research Laboratories, have been researching the overall optimization of biofuel algae growth. Algal biofuel is an alternative to liquid fossil fuels that uses algae as its source of energy-rich oils, and algae, compared to other biofuel sources such as corn, produces hundreds of times the amount of gallons of oil per acre. Over time, fossil fuel deposits within oceans will become scarce, and more expensive, whilst algae will simply be continuously regrown. Optimizing the growth of biofuel algae has been sought after since the first, proven discovery that biofuel algae will not only better the economy, but also the environment as it is a carbon neutral source of energy, rather than the carbon footprint of burning fossil fuels. My project will be focusing specifically on testing the optimal light condition to produce biofuel algae, one part of harnessing its full potential to help better energy resource production. I will grow Spirulina major in seawater growth medium over intervals of 3-6 weeks in three different light conditions: no light, UV light, and sunlight. I will allow for the algae to fully mature as if it is going to be later harvested for biofuel, recording quantitative data such as the pH of the medium and the time it takes for the algae to mature in each light condition. This data will either prove or refute my hypothesis that Spirulina major grown using UV light will increase the most in size.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) | CB BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Title: The Effect of Age and Routine Exercise on the Risk and Development of Dementia

Student Name(s): E. Daugherty, A. Brady

Abstract:

As global longevity and sedentary life increase, dementia prevalence has skyrocketed. In America alone, 5.7+ million people are diagnosed with Alzheimer's disease, a type of dementia, and that number is expected to triple in the next 40 years. Currently, there is no medicinal cure for dementia and the existing treatments only work to improve quality of life and slow disease progression. Researchers have recently started looking at lifestyle factors potentially associated with the development of various types of dementia. One lifestyle factor that has received a lot of attention is exercise. In numerous studies exercise has been found to reduce the risk for future neurological degeneration. Research has found that exercise can induce neurogenesis in the brain, which creates new connections and introduces new neurons. Age is another factor which can increase risk for dementia. People who are older (65+) are more likely to develop dementia in their aging brain. For our research we analyzed how duration/intensity of exercise and age at which a person begins regular exercise (I.e. adulthood versus adolescence) impacts cognition and dementia development by conducting a journal article review and data analysis. We first collected ten journal articles with the variables of dementia, exercise, and age. We found that nine out of ten of the journal articles found exercise to be a way to delay the onset of dementia. Those who did moderate/light exercise vs. no exercise showed a bigger decline in dementia cases than those who did moderate exercise vs. intense exercise.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☒ Yes ☐ No

CSEF Official Abstract and Certification

Title: Green Tea: The Bacteria Killer?

Student Name(s): S. Uanino, A. Tran

Abstract:

To determine if green tea prevents the growth of bacteria, the researchers took two saliva samples before and two saliva samples after drinking green tea. They swabbed the saliva onto petri dishes filled with nutrient agar, and made observations after 24, 48, and 72 hours. The research team hypothesized that if green tea was applied to oral bacteria, then there would be less bacteria in the agar plates with green tea because there are many rumors about green tea helping oral health. . After 72 hours, their hypothesis was proven correct. Green tea does in fact reduce oral bacterial growth.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

MI ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☒ human subjects   ☒ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☒ Yes ☐ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☒ Yes ☐ No

CSEF Official Abstract and Certification

Word Count
250

Fair Category
LST

Project Number
3504

Title: Development of a WatchOS Application that uses HRV and Vibrational Pulses to Reduce Stress

Student Name(s): S. Munim, A. Liu

Abstract:

Stress is a reaction that can negatively affect many people, and it has a strong correlation to Heart Rate Variability (HRV), a measure of the variation in time between each heartbeat. Research shows that vibrational pulses can reduce stress and increase HRV. The application that was created helps reduce this stress and increase HRV for people that are negatively affected. To test the application, participants were split into 2 groups, A and B, who remotely completed a stressful task of summarizing an article in the time span of 10 minutes. During the task, Group A did not revive the vibrations whereas Group B did. Before and after the task, a VAS Questionnaire was given to measure anxiety and stress levels. HRV was also measured using the application during the task. Analyzing the VAS Questionnaire, HRV averages, and task scores, the preliminary data suggests that Group B, which had received the vibrational pulses had a higher HRV and task score, while maintaining a lower result on the VAS Questionnaire. A lower score on the VAS Questionnaire signifies less stress. Greater implications of this application are to add features such as custom haptic responses, night time vibrations to enhance REM sleep, and to send vibrations when it detects irregular HRV. A separate device can be created using HRV and vibrational pulses to make the technology more affordable for people without apple watches. These implications intend to increase HRV and reduce stress, with the aspiration of improving wellbeing for people across the world.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) BE CS AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☒ human subjects ☐ potentially hazardous biological agents
☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☒ Yes ☐ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
235

Fair Category
LST

Project Number
3505

Title: Effects of Sugar Diets on Drosophila Melanogaster

Student Name(s): A. Johnson, E. Garcia

Abstract:

Drosophila Melanogaster can be used as research models that help us make many significant discoveries that can be applied to the learning of human physiology. In our experiment, we are using flies as models in place of people. The purpose of this experiment is to show the effects of Drosophila Melanogaster when exposed to a high sugar diet that will potentially cause diabetes. This idea came to us because of the potential future advancements, further insight into high concentrated sugar diets that can show how humans could potentially be affected, prevention, etc. The experiment will be set up in the following manner, flies will be separated into three groups, group one having the normal fly food recipe, group two will have a 15% increase of dextrose, and group three will have a 30% increase of dextrose. We will measure the number of deceased flies, and determine whether they died from their insulin receptors being ruined (resulting in diabetes). This experiment will follow death rates because when exposed to a diet high in dextrose we hypothesized we'd see changes in death rates, this is because the flies won't be able to metabolize all of the sugar they consume which will cause their insulin receptors to malfunction and many of them will die off. This experiment will show how diabetes in Drosophila Melanogaster affects their day-to-day actions, while also demonstrating the fluctuations in death rates.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   ME AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- ☐ human subjects
- ☒ potentially hazardous biological agents
- ☐ vertebrate animals
- ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Density of Microplastics: An investigation to determine concentration in the dorsal tissue of Morone saxatilis

Student Name(s): T. Delgado, J. Wolfram

Abstract:

The purpose of this project was to determine the density of embedded microplastics in the dorsal muscle mass of Morone saxatilis, or Striped Bass, from the Long Island Sound. It was hypothesized that microplastics would be present in at least 25% of the tissue samples and that the microplastics will be more prevalent in Morone saxatilis larger than 20 inches as compared to samples measuring 20 inches or less. Data collection required three main phases. First, striped bass were collected from a fish market and brought to the lab where they were prepared for tissue extraction. Using a tissue plug, .10g to .14g of dorsal muscle was extracted from each tissue filet, placed into an eppendorf tube, and immediately stored in a freezer at -17oC. After 48 hours, samples were pulverized and placed into a solution containing 90% H_2O and 10% KOH for 24 hours to further decompose the tissue. Samples were then sucked through a vacuum filter using 47-micron filter paper. The filtered samples were observed under a microscope to identify, count, and catalog any microplastics present. Results proved our hypothesis as 100% of the samples contained microplastics at varying levels. Statistical analysis indicated a correlation between the number of microplastics and the size, and relative age, of the sample organism.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

EV AS EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☐ potentially hazardous biological agents

☒ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

Word Count
246

Fair Category
LST

Project Number
3507

Title: The Effects of Extra Exposure to Blue Light, due to Distance Learning, on Different Age Groups

Student Name(s): E. Conway, N. Sharaf

Abstract:

The 2020-2021 school year has propelled distance learning platforms across our nation, causing blue light exposure to skyrocket for students. Previous studies have shown that blue light increases alertness and decreases focus. The purpose of this study is to determine how the extra exposure to blue light is affecting students behaviorally and academically. Conclusions from this study can be used for districts to create academic standards for teachers and course work. To execute this study, principals at Suffield Public Schools emailed our survey to parents and guardians of students in grades K-12. Survey results were anonymous and were recorded in a google sheet. Participants were grouped by age, time spent outside, and screen time. Then, we analyzed the data and compared it to our research done online. Our survey found that 47.6% of parents noticed behavioral changes in their child during the 2020-2021 school year. These changes were not seen in 77% of the students who wore blue light blocking glasses. These behaviors could also be the result of extended time sitting down, however, blue light is playing an important role. 42.2% that went outside 3+ hours a week still experienced negative behavioral changes. Many parents recorded that their child has shown a decrease in focus and an increase in hyperactivity. Furthermore, we did not find any evidence that suggests blue light affects grades negatively. Our studies prove connections between blue light and negative behaviors and our research describes how blue light causes behavioral changes.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☒ human subjects   ☐ potentially hazardous biological agents
☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes   ☒ No
4. Is this project a continuation? ☐ Yes   ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count
249

Fair Category
LST

Project Number
3508

Title: The Antimicrobial Effects of Copper on Antibiotic Resistant Strains of Bacteria

Student Name(s): N. Smith, G. Fowler

Abstract:

The project we've been conducting experiments on, targets the antimicrobial effects of copper from the antibiotic resistance found in strains of bacteria. Copper has the potential to kill other types of deadly diseases and viruses in places like hospitals and public areas where bacteria spreads rapidly. Our project has been completed by physically contacting copper to the substitute ESKAPE pathogen relatives throughout three trials. The petri dishes contain 10% TSA along with 4 groups of the bacteria used for the streaking. The eskape pathogen relatives we're using are: Pseudomonas putida, Staphylococcus epidermidis, Bacillus subtilis and Escherichia coli. Our results have shown copper's ability to fight off pathogens from the streaked bacteria. Four categories organized as control, present, after and under represent different techniques performed to find different results varying from the data recorded in each trial. The petri dishes from each group shows different reactions found due to copper encountering the different types of bacteria in certain instances. The "control" only has bacteria streaked onto the media, the "present" has copper immediately placed on the streaked media opposed to "after" representing copper placed onto streaked media afterwards and the "under" group has copper embedded into the streaked media. Over the course of several weeks, the results observed have been undeniable seeing that the absence of bacteria from the copper has been drastic. Altogether, copper has a natural ability to fight off eskape pathogen relatives because of its antimicrobial properties, and it has a lot of potential if used properly.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)
EV CB MI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human subjects   ☒ potentially hazardous biological agents
☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count
253

Fair Category
LST

Project Number
3509

Title: Converting Natural Byproducts Into Soil Compost For Crops Using the Bokashi Method

Student Name(s): L. Salazar, G. Fedus, N. Mendez

Abstract:

The Bokashi composting method is a method used to break down food and organic matter to provide plants with nutrients. Places like Hawaii and Asia typically use this way of composting because the majority of the plants grown there are anaerobic. It is an efficient way to save space rather than continuously adding waste to landfills. The Bokashi composting method will help minimize several environmental problems that society faces today, including landfills and hazardous waste disposal. Landfills all around the world release huge amounts of methane and carbon emissions. Both of these greenhouse gases contribute to climate change, which is why the global food system makes up for one third of human-caused gas emissions. This composting method reuses natural byproducts in fruit, vegetable, dairy, meat, and bone waste to provide an additional amount of nutrients for plants. The Bokashi method is simple to set up, creating the flakes that contain the EM-1 bacteria, lactobacillus casei strains. EM-1 bacteria is the microbial inoculant that enables the waste to break down. The waste products are then left for ten days, allowing the bacteria to ferment the food. The purpose of this research is to show an alternative method that is better than traditional composting methods. The simplicity of the setup and the usage of the byproducts in the compost could have a significant impact on future gardening. If America can implement Bokashi composting, it can help eliminate thousands of pounds of waste in landfills that add to environmental contaminants and global warming.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) EM EA MI

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☐ vertebrate animals   ☒ controlled substances

2. Student independently performed all procedures as outlined in this abstract.   ☒ Yes   ☐ No
3. This project was conducted at a Registered Research Institution.   ☐ Yes   ☒ No
4. Is this project a continuation?   ☐ Yes   ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count
178

Fair Category
LST

Project Number
3510

Title: A Simple Model of guideRNA for CRISPR-Cas9

Student Name(s): C. Griffin, I. Voellmicke

Abstract:

The purpose of our research is to create a model that allows for easier and more efficient guideRNA design for CRISPR-Cas9 genome engineering technology. The purpose of such a project was to ensure that students and scientists using CRISPR for the first time have a more concise way to design, order, and clone their RNA oligonucleotides. First, we researched the criteria for guideRNAs in CRISPR-Cas9 and also how to most efficiently clone these oligonucleotides into a CRISPR plasmid. Then, we found the restriction enzymes that were used in Golden Gate cloning and included the restriction sites needed on the oligonucleotides. Finally, we fused these various elements to create our guideRNA model. This model benefits younger scientists in navigating through the sgRNA portion of the CRISPR process, which can be slightly complicated. Furthermore, this model will ensure that there are less errors being made in the sgRNA design, preventing loss of materials and lab time. Overall, this model is very beneficial to the accuracy of CRISPR experiments and will make this technology more accessible to all researchers.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) CB MI BI

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
220

Fair Category
LST

Project Number
3511

Title: The Effects of Varying pH and Amyloid Levels on the Brain Cells of Zebrafish Embryos

Student Name(s): A. Recio, N. Shields

Abstract:

The focus of this literature review will provide an in-depth understanding of how amyloid formation and pH levels can impact organisms. Through our experimental investigations, we hope to answer the question: does a change in pH and Amyloid proteins in Zebrafish embryos affect their physical and neurological traits, leading to Alzheimer's, and investigate how does a deviation from homeostasis affects an organism and its properties? Our experiment involves breeding 1 male and 5 adult females together in a breeding chamber in the morning and harvesting the resulting embryos at the end of the day. Our investigation will not impact adult zebrafish. The experiment will be performed on zebrafish embryos from days 0-6.5 post-fertilization. We will have a control group and several experimental groups. One experimental group will be exposed to varying pH levels over 6.5 days post-fertilization. The other experimental group will be exposed to different concentrations of amyloid proteins over 6.5 days post-fertilization. Observations will be taken every other day during first period over the course of one school week. Examination of the zebrafish brain will be made to determine if there are any alterations in morphology and will be documented via microscopy. Unfortunately, at the time of writing this, our fish and supplies have yet to arrive and we cannot draw any reliable conclusions.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   CB

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☒ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes   ☐ No

3. This project was conducted at a Registered Research Institution. ☒ Yes   ☐ No

4. Is this project a continuation? ☐ Yes   ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes   ☒ No

CSEF Official Abstract and Certification

Word Count
249

Fair Category
LST

Project Number
3513

Title: Creating Energy with Household Food Waste

Student Name(s): J. Burke, I. Hinkle

Abstract:

Food waste is a major source of methane gas emissions. Every year, 35.8 tons of food waste rots in landfills. Our experiment investigates if we can reduce the carbon footprint of household food waste and utilize that food waste for sustainable energy.

We used dehydration and hydrogen fuel cell technology to create a device that can turn food waste into sustainable energy. Once food is placed in the dehydration chamber, heat flows into it. The heat will rise, causing the water in the food to evaporate. The water vapor then travels to and condensates in the hydrogen fuel cell chamber. After the water has collected, a 9v-battery is attached to a connector and then detached. This initiates electrolysis, when the oxygen and hydrogen ions in the water separate, resulting in electricity.

The food waste was weighed before and after to determine how much water we created. In total, 66 grams of water was evaporated from the food waste. We did not create enough water to power our hydrogen fuel cell, which needed 1056 grams of water to run. When it is filled with water, our model hydrogen fuel cell generates 1.606 volts of electricity.

Not generating enough water could have been from the lack of winter sun, losing heat from the chamber, not putting enough food waste or a combination. In conclusion, merging food waste with hydrogen fuel cell technology solves multiple issues, and is a viable option for creating energy and reducing the abundance of food waste.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   ET EN BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

219

Fair Category

LST

Project Number

3514

Title: Regenerating Transformed Plant Cells Expressing Algal Cytochrome C6 to Increase Photosynthetic Yield in Plants

Student Name(s): M. Konzerowsky, A. Arjomand

Abstract:

The objective of this project was to increase photosynthetic yield by successfully transforming flowering plants with the addition of cytochrome C6 plasmid. Arabidopsis thaliana, Nicotiana x sanderae, and Vigna unguiculata were three plant species selected for the study. The plants were grown in similar environmental conditions with a sixteen-hour photoperiod, moderate humidity and temperature, regular watering, and nutrient supplementing. Three methods of plant cell transformation were studied in a comparative analysis. In the first method, plant cells were exposed via infiltration dipping to Escherichia coli carrying the selected cytochrome C6 plasmid. (The selected plasmid also contained a short sequence for spectinomycin resistance in order to confirm plasmid uptake.) In the second method, the cytochrome C6 plasmid was isolated from a strain of E. coli and transformed into Rhizobium radiobacter (Agrobacterium tumefaciens), a bacterium with an affinity to plant tissue, followed by infiltration dipping of targeted plants. In the third method, the plant cells were directly dipped into an infiltration medium containing only the purified target plasmid with no bacterial vector. Select tissue leaflets were cut from each plant, dipped in the infiltration media, and grown on spectinomycin/agar plates. The remaining structure of the arabidopsis and tobacco plants were then entirely submerged in the infiltration media and were allowed to set seeds to be germinated on agar plates.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

PS CB AT

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
246

Fair Category
LST

Project Number
3515

Title: The Striking Strawkin Duo

Student Name(s): N. Bolineni, S. Yang, R. Bansal

Abstract:

The purpose of our project is to be able to test for benzodiazepines(date rape drugs) as discreetly and quickly as possible. Our experiment has two components: a straw and a napkin. The straw will be a normal pre-made collapsible straw with a hole that will dispense the water from the cup and will pour onto a napkin. This napkin will be made up of three layers. The middle layer will be soaked and dried in cobalt thiocyanate. Cobalt thiocyanate is a color test that will detect many drugs which all fall under the benzodiazepine category. Examples include cocaine, ketamine, etc. This would be our proposed plan for testing:

Steps:

1. Soak the middle part of the napkin in (trials 1 ml, 2 ml, 3 ml, 4 ml, 5 ml, 6 ml, 7 ml) of Cobalt Thiocyanate until the solution is absorbed.

2. Place on drying rack until completely dry (trials: 1 day, 2 days, 3 days, 4 days)

3. Layer the bottom and top layer of the napkin on the absorbed tissue and use plastic to iron the corners and the sides shut.

4. To test if it would work we would've poured 2 ml of benzodiazepines on it as well as benzodiazepines mixed in water.

This is only a theory-based method. The entire project will be based on data and research and will be considered a theory.

Our data will be in a journal for you to follow along with our process.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)

AT CH ME

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2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: The Extent of Universal Grammar Theory in Assisting English Grammar Acquisition for Post-Puberty Second Language Learners

Student Name(s): A. Paliwal, A. Kim

Abstract:

The Universal Grammar (UG) theory implies that all humans should have an equal ability to learn a language and its grammar. The purpose of this study was to determine the extent to which UG assists post-puberty second language English grammar acquisition. It was hypothesized that post-puberty second language English learners will be able to access, to some extent, UG when understanding English grammar because humans are born with access to it. Participants' background language knowledge was acquired through a language history questionnaire. Participants were then separated into pre- and post-puberty English learners. Participants then took a 10 question, 30 minute grammar test to assess the extent of their acquisition. A paired t-test would have been run to determine the extent to which UG assisted the grammar acquisition. In addition, a Fisher Exact Test was planned to be done on case study groups to differentiate the effect based on primary language. However, due to a small sample of participants, no data analysis could be performed, and thus, no conclusive statement on the effect of UG on grammar acquisition in second language learners can be made at the time of writing. If the hypothesis is valid, it would help support the claim that UG exists and is applicable to language acquisition for all ages, not just young children. This could lead to better understanding on how language acquisition works and design language classes around this information to assist second language learners in integrating into new countries.

**Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)** BE ME

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2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
206

Fair Category
LST

Project Number
3518

Title: Heat Shocking Caenorhabditis Elegans to Show Symptoms of Alzheimer's

Student Name(s): K. Caswell

Abstract:

Alzheimer's disease (AD) is a progressive disorder that causes brain cells to waste away (degenerate) and die. Currently, over 4 million Americans suffer from this disease and unfortunately, over 22,000 Americans die each year from Alzheimer's disease. In patients suffering from Alzheimer's disease (autosomal dominant hereditary), mutations in the amyloid precursor protein (APP) can be found. Caenorhabditis elegans were used in this experiment because they have the same APP gene that is present in humans. In humans when the APP gene is already mutated/ blocked Alzheimer's symptoms are present. By heat shocking the C. elegans it creates a block/plaque in the APP gene, just like in the human APP gene. That plaque build-up will make the C. elegans show symptoms of early-onset or even an advanced onset of the disease. C. elegans will present with symptoms like; difficulty moving, forgetfulness with eating, shorter life expectancy, change in how they move, and their trails. By exposing the C. elegans to the heat shock method it is going to cause plaque build-up, from there we can find a way to reverse the protein plaque which ultimately reverses the symptoms of "Alzheimer's". This research can lead to possible new treatments for Alzheimer's and Dementia patients.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   ME MI CB

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☐ vertebrate animals   ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Using CRISPR To Silence Antibiotic Resistant Genes In Bacteria

Student Name(s): R. Savoie, R. Riley

Abstract:

Ampicillin resistance or any type of antibiotic resistance is a leading cause for bacterial infections to spread from person to person which can lead to deaths from these infections. Beta-lactamase is a common enzyme produced by bacteria and can cause resistance to many antibiotics like ampicillin. In this project the goal is to use CRISPR to remove or silence this beta-lactamase enzyme. An "Out of the Blue CRISPR Kit" from Bio-Rad was used to show how CRISPR works and how it can silence or take out a gene. The kit was used to show how E. coli HB101-pBRKan can be incubated and produce blue colonies by the lacZ gene. After CRISPER is added the colonies turn white. The reason for this is CRISPR is silencing the gene lacZ. So in theory if CRISPR is used to remove or silence the gene in bacteria that produces the enzyme beta-lactamase that causes antibiotic-resistance then the current antibiotics can be used to fight bacterial infections. Antibiotic-resistance is a major health problem and something that needs to be addressed and highly emphasized right now at least 35,000 people die from antibiotic-resistance every year in the U.S. and there are more than 2.8 million antibiotic-resistant infections in the U.S. every year. These numbers could rise to almost 10 million deaths worldwide by 2050 and by 2030 nearly 24 million people worldwide could experience extreme poverty due to antibiotic-resistance.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) CB MI PS

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2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No

3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No

4. Is this project a continuation? ☐ Yes ☒ No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count
255

Fair Category
LST

Project Number
3520

Title: The Socio-economic implications of the COVID-19 pandemic on the Ridgefield, Connecticut Community

Student Name(s): C. Clifford, J. Grey

Abstract:

The COVID-19 pandemic has drastically influenced the public health of our planet. It leaves in its wake deadly respiratory, neurological, and cardiovascular issues. It has forced our societies to limit interactions, forced people to wear face coverings, and caused social connections to be severed. What is less pondered, though, is the impacts the pandemic has had on worldwide economic development. Numerous small businesses have been unable to support themselves, and even select large corporations are experiencing significant changes in revenue. The economic issues that have arisen exist on a level deeper than just industry, though. Individuals who are attempting to support their families have experienced noticeable dips in income. There has been economic science research about the impacts of the pandemic globally and nationally. However, there has yet to be specific research on the socio-economic implications of the COVID-19 pandemic on the Ridgefield, Connecticut community. The Marketplace Edison Research Economic Anxiety Index has explored the influence of the pandemic on education, income, and employment. In contrast, this local study consists of an 11 question survey opened only to Ridgefield adult residents. The survey is essential to develop a greater understanding of the specific impacts of the coronavirus pandemic on the socio-economic level for citizens of our affluent town, compared to national averages. The results from this study demonstrate that more than 65 percent of respondents experienced minimal socio-economic deficits from the pandemic. It can be concluded that the Ridgefield, Connecticut community experienced lesser socioeconomic impacts in comparison to national data.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   BE

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4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

Title: Effects of Microplastics on the Regeneration of Organisms

Student Name(s): A. Rinaldi, K. Brown

Abstract:

Our research focuses on the abundant appearance of microplastics in the food and water that is consumed by the human population. Microplastics are not only consumed by humans, but also many aquatic organisms. By understanding how microplastics can affect smaller marine organisms, it may lead to future understandings of how microplastics can affect humans. We want to know if microplastics have the capacity to be harmful to organisms. More specifically, we are interested in studying if microplastics can harm the regenerative processes of certain organisms, and to what extent. In our experiment, we will have seven groups of Nematostella vectensis and seven groups of brown planaria. One of the seven groups will be a control group where the organisms are not exposed to plastic. Three of the seven groups will have different amounts of plastic and will be exposed to the microplastic before we cut them (these will be referred to as the pre-exposure groups). The remaining three groups will have the same amounts of plastic as the pre-exposure groups but the organisms will be exposed to plastic after the organisms are cut. To compare growth we will measure the organisms with micrometers and take pictures of them in each class. As of right now, we do not have any results, but we plan to have some soon as we are currently conducting research. No conclusions can be drawn yet as we do not have sufficient data from our research.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   CB EV AS

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